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Plants and Flowers of Kansas

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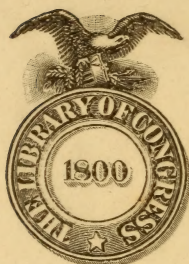
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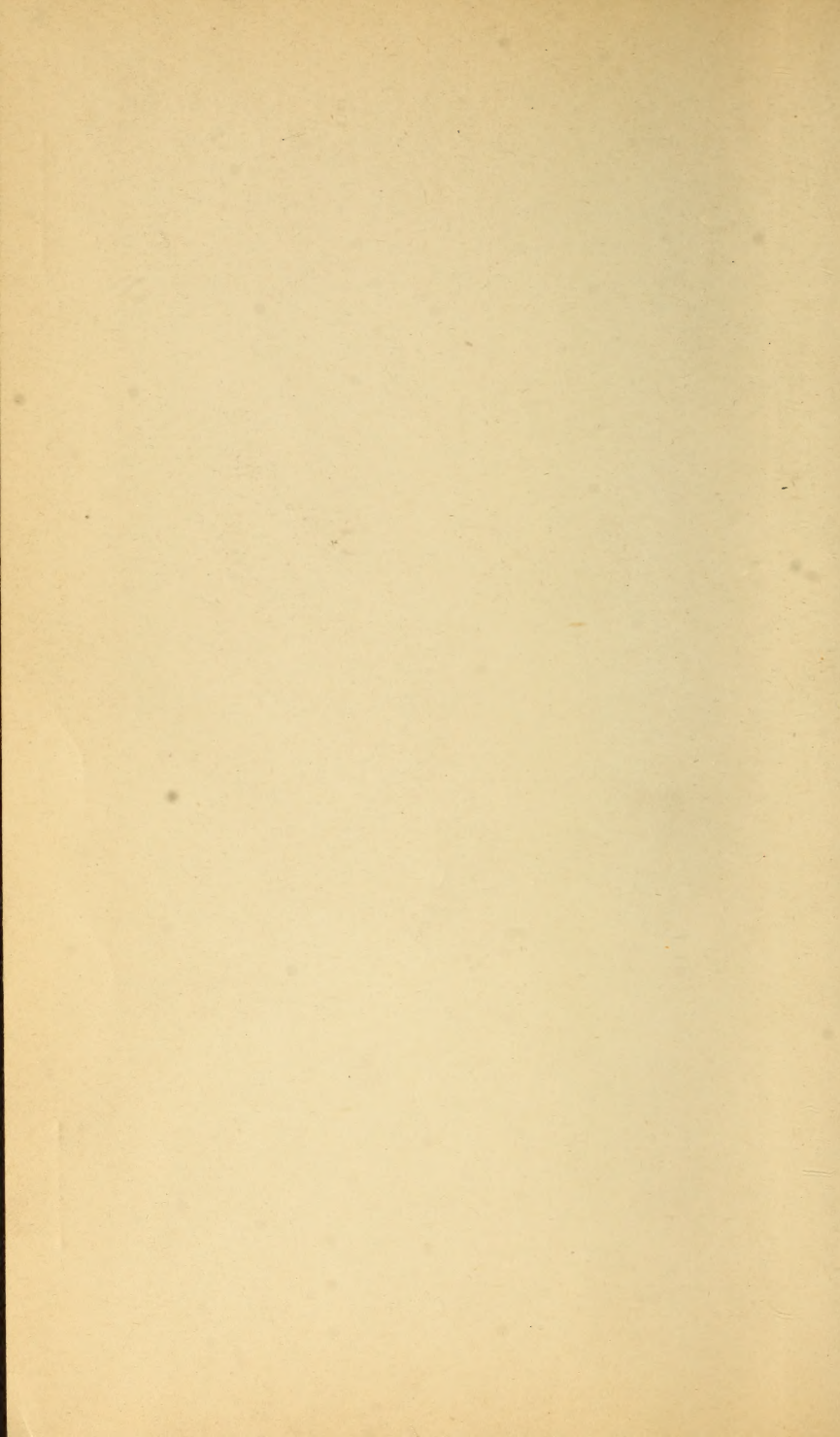
*THE TWENTIETH CENTURY CLASSICS
AND SCHOOL READINGS*

UNDER THE EDITORIAL SUPERVISION OF

W. M. DAVIDSON

SUPERINTENDENT OF THE PUBLIC SCHOOLS OF TOPEKA, KANSAS

**PLANTS AND FLOWERS
OF KANSAS**



TWENTIETH CENTURY CLASSICS AND SCHOOL READINGS

PLANTS AND FLOWERS OF KANSAS

BY

BERNARD B. SMYTH,

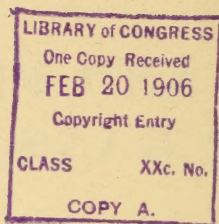
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PLANTS AND FLOWERS OF KANSAS.

CHAPTER I.

MODIFYING FACTORS IN PLANT LIFE.

Kansas, situated as it is on the confines of three different floras, and embracing many of the types of each, is well represented by many plants of widely dissimilar character. Altitude, soil, temperature, and rainfall are features that most strongly characterize the flora; other features are humidity, cloudiness, winds, and exposure.

1.—ALTITUDE.

The altitude of the State varies from 750 feet above sea-level, at the mouth of the Kansas river, on the east line of the State, to 4,000 feet on the west line of the State, between the Kansas and Arkansas rivers.

A small portion of the easternmost part of the State, mostly below 1,000 feet altitude, is partially covered with timber, and contains a very large percentage of the plants of the Mississippi valley. The western half of the State, 1,000 to 2,500 feet higher, contains nearly all species of plants of the Great Plains which are found from northern Texas to British North America. The southeasternmost corner of the State, and a few of the counties along the south line, in the eastern part of the State, mostly below 1,000 feet altitude, contain a large

sprinkling of southern plants, not essentially subtropical, which grow all through the Southern and Southwestern States. There are no alpine or arctic plants in the State worth mentioning as such.

There are no great elevations to be found in the State. The rise from the eastern line of the State to the western line, interspersed as the State is with river valleys, is very gradual and in most cases quite imperceptible. In no place is the difference in elevation between the highest headlands and the bottom of the adjacent valleys greater than about 250 feet; and in most cases it is much less.

2.—SOILS.

Soils are largely controlled by geological formations which overlap each other in a regular ascending series from east to west, beginning with the Subcarboniferous in the southeastern corner of the State, followed by the Carboniferous in the eastern third, the Cretaceous in the central part, and ending with the Tertiary in the northwestern corner of the State.

There is a large triangular tract, comprising about seven counties, in the south-central part of the State, with its apex in the "great bend" of the Arkansas river, and its base on the south line of the State, from Caldwell west to the Cimarron river, near Englewood, which may be appropriately called the great Red Delta of Kansas, in which the formation (known as "red beds") appears to be of Triassic age, between the Carboniferous and Cretaceous. Its principal characteristic is red earth.

Lines of outcrop as they strike across the State are nearly north and south, varying a little to the eastward of north and westward of south, but without crossing the

Arkansas river. This causes zones of similar soil to extend across the State from north to south.

Soils in the eastern part of the State are made up of clays, limestones, and shales, containing a very fine, almost impalpable, grit. They are moderately fertile, especially where covered with alluvial deposits.

In many places south of the Kansas river the hills are almost barren, consisting of unreduced shales and limestones.

The northeastern corner of the State, as far south as the Kansas river and west to the Blue, is covered on the hills and plains with what is called "drift," material brought in from the north by ice action and reassorted by water. It is, wherever found, of the most fertile character, both as regards tillage and ability to retain water.

Soils in the central portion of the State are largely sandy, with good admixtures of lime, salt, gypsum, and loam, making lands that are light, easily worked, and of the most inexhaustible fertility. Water is abundant, nearly everywhere, at depths of fifteen feet or more.

An important feature of the soils in the great red delta south of the Arkansas river is their bright red color, like brickdust or darker, as though the earth were colored with oxide of iron. These soils, where long exposed and mixed with humus, are exceedingly fertile; and, even where the soils are fresh and the admixture of humus is small, these soils are found to be excellent wheat lands.

In very many places in Sedgwick, Reno, Stafford, and Edwards counties, these red lands are covered with a very fine sand, largely blown up from the Arkansas river by the north winds of winter when the river is usually dry. Such soils, when the sand is deep, are usually too

light to be valuable, and their recommendation is their ability to hold moisture in dry seasons. In places, owing to the purity of the shifting sand, nothing whatever grows; in other places straggling plum bushes and sand-grass (*Calamovilfa*) are about all that may be seen. Again, where there is a greater admixture of humus, all kinds of sand-hill vegetation grow in great profusion.

In many places, where there is no sand, the soils are highly gypsiferous and saline, having the power to absorb much moisture from the air and underlying water stratum, and hence are moist and fruitful nearly all seasons.

Soils in the northwestern part of the State are largely composed of clays, gravels, and coarse sand, being here quite fertile and there quite barren. These soils are generally fruitful; though not so much so as the cretaceous and saline lands of the interior. Water is absent in most places, but abundant in certain zones, as though occupying the ancient channels of buried river valleys. Artesian water of the purest quality is obtainable.

Soils in the lower Kansas valley are composed of finely comminuted chalk, sand, and alluvium. In most places they are mixed in various proportions. In many places, by reason of the sorting power of water during floods, the chalk and sand, being of different specific gravities, are separated and deposited nearly pure. Afterward they are acted upon by the wind to some extent and rendered impure.

Soils in which chalk largely predominates are to be seen in the valley near Topeka, near Tecumseh, and other places; they are mostly gray or whitish, the earth

finely comminuted; do not rise readily by the wind; and have a moderate capacity for holding water. The chalk was brought down by the Republican, Solomon, Saline, and Smoky Hill rivers, from western Kansas.

Soils in which sand predominates may be found almost anywhere in the valley not far from the river, or not far from an old river-bed where the river once ran. Sand is carried down by all the rivers of Kansas, mostly from central Kansas and eastern Colorado. Sandy soils have good capacity for holding water.

Gumbo lands are found in low spots remote from the rivers and creeks; or at least far enough away from the rivers that no sand is deposited during an overflow. The clay of the muddy water of a river is held in suspension longer, carried farther from the stream, and deposited in lower grounds, old river-beds, etc., where the currents are comparatively slack, or where the water rests after the flood has receded. Gumbo soils are impervious to water. They are very wet and glutinous in wet weather; very dry, caked, and cracked in dry weather.

In an overflow of any river, when the muddy water is carried all over the valley, the sand is deposited first and nearest the stream; chalk next, and farther out; heavier clays next, where the currents are slack; and the lighter, more soluble clays last, where there is no current.

That accounts for the lands of a valley next to a river being higher than those remote from the river bank, when the valley is broad enough not to be affected by wash from the hills. That gives in any valley a variety of soils, which necessarily influences vegetation.

The Arkansas valley, from Colorado to the Oklahoma

line, was once very deep in most of its course. It is now filled up with sand from 20 or 30 to 150 feet deep, overlaid by a covering of a sandy, earthy, alluvial soil from 6 to 18 feet deep. The substratum of sand is filled to the top with water. The surface of the water is usually from one-half to two and one-half feet above the water of the river, owing to capillary attraction of the earth. (It is less during a rise or freshet.)

Thus, vegetation, being able to reach permanent moisture with its roots, is necessarily of a different character from the vegetation of the high plains. And being adapted, in its aboveground parts, to the hot sunshine and strong dry winds, is essentially different from the vegetation of a moist climate in the same latitude.

Thus it will be seen that, not only does the nature of the soil modify vegetation, but the condition of the soil as regards water-supply and its capacity for absorbing it, also modifies it.

3.—TEMPERATURE.

The northwestern corner of the State has the lowest average temperature, and there are no so-called subarctic plants to be found, with the exception of a very few. The mean temperature of the State is between 54 and 55 degrees, along a line drawn from Troy and Atchison, near the northeast corner, through the center of the State, to the southwest corner. The mean temperature of the northwest corner is about five degrees lower and of the southeast corner about three degrees higher than the central portion.

The mean temperature of the three summer months in

the central part of the State is 76° , and of the three winter months is 31° . The mean temperature of the permanent subterranean water-supply, as determined by wells 15 to 25 feet deep, throughout the central part of the State, is about 53° degrees; in fall and winter about two degrees higher, and in May and June, when it is lowest, about two degrees lower. Deep wells remain about 52° to 53° all the year around.

The highest temperature at the surface of the ground on the open prairie in the western part of the State is 133° , and on a sandy southern hillside may be as high as 142° at 2:30 in the afternoon. Such temperatures may be experienced any very hot day in July and August, when record thermometers register 99° to 102° .

Observations on earth temperatures, made by the writer in Barton county, central Kansas, in 1875 to 1879, showed that the earth frequently attained such temperatures as these, even when the air at the surface was no higher than 122° ; one inch below the surface, 133° ; two inches below, 131° ; four inches below, 121° ; six inches below, 102° . These temperatures are frequent in midsummer.

The lowest temperature of winter in similar locations is often 20° to 26° below zero, and on rare occasions may go as low as 32° below, as in February, 1899. When the ground is not covered with snow the temperature of the earth, for the first inch or two below the surface, when radiation is strong, should be almost equal to the air in intensity of cold.

Another feature connected with the temperature of the western plains should be borne in mind, as it must affect largely the character of the vegetation, namely: *Changes*

of temperature. A difference of 30° to 40° between the extremes of night and day temperature is quite common. A fall of temperature of 30° in two hours during the middle of a storm is frequent. A rise of 30° in three hours occasionally occurs. A monthly range of 60° is usual. A monthly range of 100° in winter is not unknown. A yearly range of 134° is recorded by the U. S. Weather Bureau as having occurred in 1899.

Thus it will be seen that vegetation, to be able to endure such temperatures and survive, must be of the very hardiest kind.

Such temperatures and changes of temperature are generally supposed to be destructive to plant life; but the following plants live through them and continue to thrive: Pincushion cactus, prickly pear, thistle poppy, Rocky Mountain bee plant, spider-flower, clammy weed, buffalo pea, loco, turkey bean, leather-root, devil's shoestring, hoffmannseggia, carpetweed, mentzelia, golden-aster, western goldenrod, hookeria, flaveria, rosinweed (*Grindelia*), aplopappus, golden senecio, sandhill sunflower, gaillardia, dogfennel (*Dysodia*), engelmanna, wild sage (*Artemisia*), gas-plant, wild lettuce, western thistle (*Carduus*), buffalo bur (*Solanum*), gilia, pentstemon, mountain mint, wild gourd, devil's claw, hoary goose-foot, tumble-weed, croton, numerous sparges, and many other plants; though these are the most noticeable that bloom or remain in bloom in the middle of the day.

Many of the plants of the plains flourish during the season when the weather is not so inclement, and rest or lie dormant during the terrific heat of summer as well as the cold of winter. Of this kind are all the annuals that

ripen their seed in June, and such "biennials" as start from seed in the fall and ripen their seed early next summer. There are very many examples of these in the crow-foot, mustard, pea, evening-primrose, spurge, and goose-foot families.

Many other plants of the same region seek situations sheltered from the burning sun, or are quiescent during the heat of the day, as wild four-o'clock, fragrant abronia, heliotrope, the evening-primroses, gauras, dwarf morning-glory, bush morning-glory, crimson poppy-mallow (*Callirhoe*), scarlet mallow (*Malvastrum*), day flower, spider-wort, etc.

Other plants, as buffalo-grass, prairie june-grass, wild wheat-grass, etc., have passed their season and are lying dormant; others are waiting for the cooler fall; as most of the composite plants, goosefoots, joint-grasses, spurges (including "snow-on-the-mountain"), etc.

The highest temperature in the woodlands of eastern Kansas is about 97° to 100° , rarely so high, and the lowest temperature in similar situations is about 12° to 18° below zero, though seldom below zero. Plants less hardy than those found on the prairie may endure in the woods.

4.—RAINFALL.

The total annual rainfall of the State varies from 38 inches in the eastern part of the State to 15 inches in the west, the average being about 27 inches in the central part. Lines of equal annual rainfall cross the State nearly north and south, and are almost identical with elevation-contour lines and nearly coincident with meridional lines. The principal part of the year's precipitation falls between the

months of April and July, just when most needed by growing crops. The following table shows the fall by seasons:

	Western One-third.	Middle One-third.	Eastern One-third.	Average for State.
Winter (Dec., Jan., Feb.)	1.66	3.02	4.50	3.06
Spring (Mar., Apr., May)	5.50	7.83	10.73	8.02
Summer (June, July, Aug.)	7.86	10.53	13.10	10.50
Autumn (Sept., Oct., Nov.)	3.59	5.68	7.68	5.65
For the year	18.61	27.06	36.01	27.22
Growing season (April, May, June, July)	10.09	13.72	17.71	13.84

Thus it will be seen that the State has plenty of rainfall during the growing season for the growth of ordinary plants; and, while there is no particular time of day for maximum rainfall, unless it should be at night, it very rarely happens that there is a drouth during the months of April, May, and June.

On an average, more rain falls in July than in April; but it frequently happens that a drouth occurs in July; while none of any consequence ever happens in April.

In attempting to introduce exotic plants of any kind for cultivation, it becomes necessary to study the climatic conditions, and introduce first those that are best adapted, or that live in similar climates in other countries.

5.—HUMIDITY.

This is seldom very great. The climate of the plains may be termed arid. When, after a three-days south or east wind, the temperature and humidity of the atmosphere have greatly increased, it requires a rapid fall of temperature without an accompanying increase of wind, to cause precipitation.

Evaporation in the central part of the State is greater than the rainfall; in the western part of the State is much greater; and in the eastern part of the State is greater on the open prairies and exposed situations, but somewhat less in the woodlands. On the whole, in the eastern part of the State there is a slight surplus of waters that run off in the rivers.

6.—CLOUDINESS.

The amount of cloudiness varies from about 40 per cent. in the eastern part of the State to about 5 per cent. in the western part. This gives a large amount of sunshine, especially in the western part of the State, and is an important factor in modifying the character of the vegetation.

7.—WINDS.

The prevailing winds of the State are southerly in summer, northerly in winter. In summer-time, when the weather is fine, the wind begins to rise in the morning, increases in intensity to a stiff breeze or a strong wind about one to three o'clock; drops to a gentle breeze at sunset; then increases to a stiff breeze during the night, to fall again toward sunrise. The night winds are less than the day winds, except in case of a storm.

On approach of a storm the south wind may increase to a strong wind or even a high wind during the day, fall a little toward sunset, and again increase to a high wind or even a gale during the night. This may continue for two or three days. Storms nearly always approach from the west, northwest, or southwest; a hail-storm nearly always (though such storms are rare) from the north. During the approach of the storm the wind continues to

blow from the south, southeast, or southwest, accompanied by rain toward the last. The winds blow toward (or nearly toward) a storm center.

As soon as the storm center has passed, the wind changes, usually with a slight calm intermission, to the northwest or north, and blows violently for a few hours, then settles down to a strong wind for a day or two.

In unsettled weather, winds change rapidly and are uncertain, and are usually accompanied by much rain.

8.—EXPOSURE.

Under such circumstances, with vegetation exposed to the full effects of the breezes, the foliage must be of such character as will endure severe treatment. Hence we find foliage with comparatively few breathing-pores in the leaves, and they small and narrow, and much hairiness, tending to reduce evaporation from the leaves and stems. We also find small leaves predominating or pinnate leaves with small leaflets, or pinnatifid leaves with deep divisions and narrow lobes. If leaves are large, then they are very rough, as the sunflower. Leafless plants are not infrequent, as gas-plant (*Lygodesmia*), broom-rape, and the cacti.

CHAPTER II.

PLANT SOCIETIES.

Vegetation in general in the State may be divided into eight groups, namely: (1) Water plants; (2) marsh plants; (3) woodland vegetation; (4) prairie flowers; (5) sandhill flora; (6) salt-marsh plants; and (7) plants of the plains.

1.—WATER PLANTS.

Most noticeable among water plants in the eastern part of the State, in fresh-water ponds where the water is from two to four feet deep, is the white water-lily (*Castalia*), with beautiful, fragrant, many-petaled white flowers, and large floating leaves. The flowers open at six o'clock in the morning and close between three and four in the afternoon. The plant, although so noticeable, is quite rare even in eastern Kansas, and does not occur in the west.

A more frequent plant in similar situations is the common yellow pond-lily (*Nelumbo*), or sacred bean, called by the Indians "yonkopin." In this species the leaves mostly stand out of the water and are peltate. In the flowers the petals and stamens are in many rows or whorls surrounding the obconical ovary and growing from its base (around the point, as the cone is inverted). The sepals and petals, which are large and broad in the outside rows, gradually grow narrower and change to stamens inside. The top of the ovary is broad and flat and contains two or three circles of brown oval beans, with a small neck,

each bean in a separate receptacle, with its neck and shoulders standing out, and when ripe, loose and rattling in its receptacle. The roots of this plant are large, farinaceous, and edible.

A common water plant nearly all over the State, though often in marshy places where the water nearly dries out in summer, is arrow-head (*Sagittaria*). It has very long and large leaf-stems, with blades that are arrow-shaped, with very long and tapering earlobes. The flowers are on tall racemes, in whorls of three, far apart on the stem, and with the male and female flowers separate, often on separate plants. When on the same plant the upper whorls are staminate or male, the lower whorls of flowers are fertile or female. The flowers have sepals three, petals three, white, all spreading. The stamens are numerous; the ovaries are numerous and crowded into a spherical head.

A somewhat similar plant of shallow water and ditches in alluvial districts is alisma or water-plantain. The leaves are oblong, ovate, or cordate-ovate, all rising from the root, and with leaf-stems merely a narrowed portion of the blade. The flowers are like the arrow-head, but smaller and perfect; each flower has male and female organs; that is, they have both stamens and ovaries.

Very frequent plants, though not very noticeable, in water that is deep enough to be permanent, are water-crow-foot and water-milfoil. The leaves of these plants are subdivided into very fine divisions. They are much sought after as plants for fish-tanks and aquariums.

Pondweeds are frequent, and not very interesting. They have floating ovate or cordate-ovate leaves, with very long

petioles or leaf-stems, and lie mostly all in one direction, according to how the wind blows.

Rushes are frequent, though not common. Bulrushes are frequent in water-holes in western Kansas. The flowers of rushes are liliaceous in structure, but sedge-like in appearance. Bulrushes are altogether sedge-like, except that the stems are terete, instead of triangular, and the leaves are few and unnoticeable.

In fresh spring streams, on hard land in Morris and Russell counties, grows a species of water-cress (lake-cress) that is difficult to distinguish from the true water-cress. It only grows in ditches of permanent water of the freshest kind.

A plant that may be considered a water plant is the water-hemlock, a stout plant of the parsnip family, 3 to 6 feet high, with large pinnately-compound leaves and hollow jointed stems, of which the boys often make "squirt-guns."

Common in the shallow permanent waters of the Ninnescah, Chikaskia, upper Neosho, Wakarusa, Shunganunga, and other streams of southern and eastern Kansas, is to be found sometimes vast quantities of jussiaea, a water vine of the evening-primrose family, with yellow flowers, rising out of the water on long calyx tubes, and with four petals and eight stamens, like other plants of the same family.

In shallow rocky streams in Morris county and farther east grows a plant of the acanthus family, with an erect stem, opposite leaves, and compact clusters of violet, two-lipped flowers, on a long peduncle. There is only one pair of stamens, hidden under the upper lip. The plant is called water-willow, on account of the form of the leaf.

2.—MARSH PLANTS.

The characteristic marsh plants of the North are nearly all absent from the marshes here; and yet we have a large number of plants that make their home largely in wet places. They are for the most part inconspicuous and uninteresting; and some of them, at least, have been introduced from the East.

a.—GRASSES AND SEDGES.

Most noticeable are the grasses and sedges. There are so many kinds that differ so little in general appearance that an attempt to distinguish between the different kinds would be out of place here. It requires technical language. It will be sufficient here to point out some of the differences between a grass and a sedge, so that the reader of this may not make the mistake of calling a sedge "grass."

Grasses have terete or cylindrical hollow stems, with solid joints at certain distances. Leaves are one in a place, and alternately on opposite sides of the stem. Each leaf starts at a joint; though it seems to start from the plant stem at a short distance above the joint. The lower part of the leaf, which corresponds to the petiole or leaf-stem in other leaves, is called the sheath, and completely and closely surrounds the stem of the grass. At the top of the sheath the blade is attached at as much of an angle as circumstances will permit; and there is usually more or less of a fringe at top of sheath. Indian corn, wheat, and rye, are familiar examples of grasses. If it be objected that corn-stems or stalks are not terete, but have a groove on one side, next to the leaf, so it may be shown that that is true of all grasses, only to a less degree.

Sedges have rush-like (solid) triangular stems, with grass-like leaves. The leaves are single and follow around the stem, one at each angle. The sheaths of the leaves are continuous with the blade, and are not joined to the blade at an angle, as in the case of grasses.

b.—TREES AND SHRUBS.

In this class of marsh plants must be placed the willow trees and shrubs that form so conspicuous a feature fringing our streams and standing in clumps in the marshes like sentinel buffaloes guarding the herd drinking at the river.

Willows have their male or pollen-bearing and female or seed-producing flowers on separate trees, and depend on the wind for pollenization. The staminate or male catkins are the only ones desired for a bouquet. The pistillate or female flowers are comparatively inconspicuous.

First is the glaucous willow, or pussy willow, as the girls and boys call it, along river-banks, the earliest to bloom in the spring, the seed-capsules being nearly full grown before the leaves appear. The rather broadish leaves are usually furnished with stipules, which, however, fall early. The trees grow to a height of 15 or 20 feet.

Next is a willow similar to this with silky leaves, and it is hard to draw a dividing line between the two, as many trees have leaves silky when young, and glaucous or smooth when old.

The black willow is a pretty fair-sized tree, usually in thickets in low grounds near the river. The tree has slender aments, which appear with the leaves. The leaves are narrow and furnished with persistent stipules.

The peach-leaved willow is common near rivers, and not easy to distinguish from other broad-leaved willows. The aments appear with the leaves, which have no stipules.

There is a remarkable form of the river-bed willow growing in the sands of the Arkansas river and elsewhere in western Kansas, which seems to have its principal stem underground a few inches below the surface. It casts up small aërial stems two to four feet high all along its course. The writer, on one occasion, at Garden City, measured one of these stems washed out by a freshet and lodged on the piling under the bridge. Its length was 55 feet; its diameter was about two inches, and nearly the same from end to end. It had two branches about equal in size. All four of the ends were broken. It had numerous one- and two-year-old willows attached to it at right angles, all alive. Other similar vines, caught against the upper piles, were long enough to cross the bridge double, and had one or both ends floating in the current below the bridge, showing a length perhaps equal to the one in hand.

A beautiful shrub of the marshes, usually growing just in the edge of hard land, is the "lead-plant," miscalled "water-locust," though the name "lead-plant" is also a misnomer. It is about 5 to 8 feet high, in dense clumps, with pinnate leaves 6 to 10 inches long, and with about 11 to 17 or more small oval or elliptic leaflets, with a small point at the tip of each. The flowers are very small, in dense erect terminal spikes three to six inches long, and single or two to four or five spikes in a bunch. Flowers of the pea family are unique, having usually five petals consisting of the "banner," above; the "wings," at the sides; and the

“keel” of the two lower petals joined and enfolding the pistil and stamens. This flower (*Amorpha fruticosa*), though of the same family, differs in having only the banner, which is a deep dark blue, and enwraps the essential organs like a cloak. The fragrance of this plant is very pleasant and quite remarkable. When the wind is right it may easily be discerned at half a mile or more, when approaching it.

Another very interesting shrub of the water-holes is the button-ball bush, usually growing in clumps. It has rather large ovate leaves, commonly three in a whorl, sometimes two at the beginning of the summer's growth. Its florets are very small and packed into solid globose heads which terminate the branchlets. It also is fragrant.

There is an interesting shrub with considerable individuality, growing on the banks of streams which flow through hard-land woods. It is the silky dogwood; grows in clumps; and has blue berries when ripe, in broad cymose clusters.

Conspicuous and common in rich soils, near rivers, springs, and other permanent fresh water, are the horse-tails. These have erect, green, cylindrical, jointed, hollow stems, with a whorl or crown of very small, white-margined, sharp-pointed, black teeth, surmounting a short sheath covering each joint. There are no other leaves. The stems are fluted or ridged and have a silicious cuticle. The branches are angular and similarly jointed. Owing to the uses to which they were formerly put they are commonly called scouring rushes. Boys use the larger joints for ready-made whistles.

Joint-weeds are common in low places. They are of

many kinds, including water joint-weed, water-pepper, tannin plant, heart's-ease, lady's-thumb, and smartweed. The leaves of most of these species are comparatively broad, with a short petiole attached to and surmounted by a bootleg-sort of sheath that surrounds the stem of the plant like a collar, with its upper edge sometimes plain, and again torn a little; now with a hairy fringe, and then with a broad leaf-like expansion quite ornamental. The flowers are in rose-colored or white spikes, erect or nodding, very sweet-scented and abounding in honey. The little florets have 5, 6, or 8 stamens, according to the species, and each floret has one triangular or lenticular seed. The species called bird-grass and dooryard-weed, with narrow green leaves, are not water or marsh plants.

C.—HERBS.

In marshy spots, in summer-time, and in the borders of woodlands, in low ground, we may find plenty of starry campion, with flowers an inch across, with five white fringed petals. The plant is rather slender, about three feet high, with four ovate or lanceolate leaves at a joint (sometimes two), and a panicle of flowers at the top that open in the afternoon. The flowers are very handsome.

Conspicuous in marshes is the swamp milkweed or silkweed, which grows in clusters of several upright stems, three to five feet high, branched at the top, with lance-pointed opposite leaves and large umbels of very fragrant rose-purple flowers. They are a great attraction to butterflies and beetles. The seed follicles are usually in pairs and erect; the inner bark of the stems and branches has a very strong fiber from which Indian hemp is made.

Growing in sandy soils by the banks of a stream, but by

no means so common a plant, is the regular Indian hemp, which is also a milkweed, though a different branch of the same order—dogbane—in which the flowers are in cymes instead of umbels; styles are united and stamens distinct, instead of styles distinct and stamens united; and the two seed follicles are pencil-like, long, slender, taper-pointed, and pendulous, like a pair of tongs.

The cardinal flower and great blue lobelia are great favorites on account of their brilliance of color and unique form of flower. These are desirable flowers to combine with fleabanes and other composite flowers of the fall. Growing by the side of streams or near water, they are as rare in this State as they are desired. These are all autumnal flowers.

In wet, marshy spots, along the Arkansas river and in southwest Kansas, grows a plant of the sunflower family called *Iva*, allied to the ragweed. In our fields of eastern Kansas it was supposed to be an eastern plant introduced; but here it is in southwest Kansas found in the marshy spots anywhere all over the plains.

Early in August, 1899, in all the roadside ditches, along the lower road between North Topeka and Silver Lake, they being more or less filled with water, appeared vast quantities of mud plantain, 3 or 4 inches high, with numerous violet 6-parted flowers, one inch across, somewhat irregular, longest up and down, anthers unlike, and each flower growing in a green spathe or cloak, like jack-in-the-pulpit. The leaves are shaped like the "spade" emblem on playing-cards, except that they have long petioles. How happens it that this plant was then in great profusion along ten miles of road, and had never been seen or reported in

the State before during forty years' residence? The plant has been there all the time. Its season is the last of July and month of August. Whenever there is plenty of water on the mud during its season it grows and blooms; otherwise its seeds lie dormant, awaiting its opportunity. None have appeared so far this year; though there is plenty of rain and probably plenty of time.

3.—WOODLAND VEGETATION.

a.—TREES AND SHRUBS.

There is very little true forest in Kansas; at least there is no "timber-land," such as is known in New York, Michigan, and Wisconsin. The trees, which grow generally near streams and on broken hillsides, where they are in a measure protected from fire, are of a scrubby kind. They find plenty of sky without the necessity of growing tall.

Nevertheless, the amount of woodland in the State is rapidly increasing; first, from the non-destruction of what little timber there is in the State, and protection from fire; second, from the planting of numerous "timber claims," and the subjugation of prairie fires. The time is coming when all ravines and broken ground in Kansas, whether near a creek or not, should be covered with trees of some kind.

February and March.

The first blossoms to appear in the early spring are on the hazel, in the thickets of eastern Kansas, the male blossoms of which are conspicuous, hanging as catkins from the naked branches of the bushes in February and March. When the weather is exceptionally fine the hazel blossoms open and shed their pollen in February; but ordinarily

blossoming takes place in March. The female blossoms of the hazel are small, green or reddish green, and inconspicuous, hidden in the axils of the leaf-buds.

Among the trees to bloom toward the last of March are white maple and white and red elm. Only the male blossoms on those trees are at all conspicuous; and were it not that the trees were entirely leafless, the blossoms would not be noticed.

White maple trees bloom in March, about the time of the vernal equinox. The seeds ripen in May, shortly after the leaves have expanded. They should be planted as soon as ripe; and do not need frost to make them germinate. White maple is a soft maple, sometimes called silver maple on account of the whiteness of the under side of the leaf. Another of the soft maples that is well known, red maple, does not grow in Kansas, except a few trees in the extreme northeastern corner of the State.

The seeds of elm ripen toward the last of April or May, before the leaves appear, or just as the leaf-buds are expanding. Elm, although one of the first trees to become green early in the spring, is one of the last trees to leaf out. The first greenness is caused by the seeds growing. It occasionally happens that, by reason of a cold storm about the last of April, the ripe seeds are blown off, making the trees bare as in the winter; then in a few days the leaf-buds open and they become green a second time. The leaves are obliquely ovate, beautifully toothed, and arranged in rights and lefts, like a pair of shoes.

White elm is reasonably well adapted to dry lands, though either white or red elm will grow there. The elms like plenty of fresh water. Twigs and buds have much the

same appearance in each. The seeds are green, soft, flat, thin, orbicular or oblong, with a narrow wing all around the margin. White-elm seeds have a small notch in the margin at the style end of the seed. Seeds of the red elm are a little larger and broader than the white, and have no notch, but have two small styles.

Sugar maple grows sparingly in the eastern part of the State.

April.

Cottonwood trees bloom early in April (6th to 12th), and ripen their seeds from the 10th of May to the end of the month. Male or staminate blossoms and female or pistillate blossoms are on separate trees. The blossoms are all in the form of aments or catkins, and grow on wood of the second year. The staminate blossoms when fully expanded are reddish or purple; the pistillate blossoms are a dull green. The male aments fall off as soon as blooming is ended; the female aments remain on the trees until the seeds have nearly all blown away, in May, or early June. The seed catkins, resembling necklaces, on the female trees are fully expanded and the trees are green, except the terminal branches, for three weeks before May 1st, when the leaves begin to appear. The male trees start their leaves a few days earlier.

From the time the first blossoms appear, in April, until the last of the seed has fallen, in May, the male trees can be distinguished from the female. Cuttings taken from male trees grow into trees that produce only staminate blossoms and never bear seed. Cuttings from male trees only should be planted.

A very beautiful small tree that will be found in bloom,

not far from rivers all through southeastern Kansas, as far north and west as Pottawatomie county, is the redbud tree. Its period of bloom is from the middle to the 25th of April, and with its bright crimson flowers is a most entrancing sight, and may be discerned for a long distance in the edge of a piece of woodland. The blossoms are pea-blossom-shaped, but with smaller banners, and grow in loose clusters on the branches of two years' growth; last year's branches contain only leaf-buds. The leaves, which appear after the flowers have passed, are round-heart-shaped, simple, with radiating veins, and so are remarkably different from all leaves of trees and plants of the pea family, which are nearly always pinnate and feather-veined.

In April, on steep hillsides, near creeks and rivers, grows the bladder-nut, a shrub 6 to 10 feet high, with trifoliolate leaves and clusters of small white flowers in the axils. The fruit is in the shape of a pendent prismatic sack, composed of three peculiarly shaped leaves, about two inches long, folded face inward along the midveins and joined together bellows-fashion by their margins, then inflated. The seeds are very small and globular.

The pawpaw is a small tree that deserves notice. It grows singly in communities of pawpaw, in low woods. Its leaves are very large and obovate, almost tropical-looking. Its blossoms, which open with the leaves in April, are a dark purplish brown, almost invisible, and about an inch across. The soft, pulpy, luscious fruit, which ripens in October, is liked by some almost as well as the banana.

The common red plum of our woodlands must not be omitted in mentioning the early trees. It is especially attractive at two seasons of the year: first, in early spring, before the leaves appear, when the delicious fragrance of

the blossoms may be perceived for a great distance, and tempts many a person to cut a bouquet for the button-hole or the house.

There are few trees more beautiful and fragrant than the little haw trees, with their wealth of white rosaceous blossoms early in the spring when the plum and cherry are in bloom. They are frequent and conspicuous objects in the woodlands of eastern Kansas. There are several species; but they differ so little in habits and general appearance that it takes an expert to distinguish them. The branches of these trees are the boys' favorite for shinny-sticks. The crook at the big end is just right; and they are so tough they never break. But it requires a strong wrist and a sharp knife to prepare them.

The wild crab-apple is if anything a more frequent and beautiful tree than the haw, not in the general shape of the tree but in the size and color of the flowers, which are much larger, though in smaller clusters, and rose-colored instead of white; and the fragrance is more penetrating as well as deliciously sweet. There is a variety here with narrower foliage, differing noticeably from the wild crab-apple of Michigan, but not more than should be expected from the difference in climate. The differences are hardly marked enough to constitute a separate species.

The dwarf buckeye is a small tree or large shrub, growing in rich soil on the hard, well-drained land along the creeks of eastern Kansas. The large terminal panicles of purple and yellow flowers in April are very attractive; and the rich foliage is particularly pleasing. Attempts to transplant this beautiful shrub to dooryards have been but poorly crowned with success.

May.

Red mulberry trees are occasional in our woods. They bloom early in May. The fruit is now well grown, and will be ripe in July. The leaves, which are commonly heart-ovate, with saw-tooth edges, are occasionally lobed on one or both sides; and when the stem is a young sprout from an old stump, and is rapid-growing, the form of the leaf is the most fantastic imaginable. Lobes and serration do not then express it. It is positively grotesque.

Hackberry is an early bloomer, and is frequent in places. It makes a beautiful shade tree. It is preferable to the elm for the following reasons: It is a smaller tree; it is more symmetrical, growing with a single erect stem and horizontal branches; its dark bark is more gracefully broken up than that of the elm; its leaves are quite as regular and handsome as those of the elm; it is not affected by insect pests; its berries are agreeable. An objection to it is that it is occasionally affected by a fungus that causes its foliage to grow in green clumps early in the spring and late in the fall before the natural leaves appear on the trees, and after they have fallen off. It also causes green foliage to remain growing on otherwise dead trees, as near a brick kiln, where the trees are all killed by the fumes of sulphurous gases from the kiln. The following trees were noted as being killed in a ravine 900 feet north of a kiln near Topeka: White elm; white ash, box-elder, pignut hickory, hackberry. But the fungoid foliage on the hackberry was not killed, and gave the tree that bore it a very singular appearance, with little clumps of unnatural blue-green foliage all over the branches of apparently dead trees, reminding one of the

deciduous trees south of the Ohio river in winter-time, when covered with evergreen mistletoe.

Seven species of oak may be found in bloom early in May, namely: Scarlet oak, black-jack oak, water oak, post-oak, bur-oak, swamp white-oak, and chestnut oak.

In the oaks the male blossoms hang in slender aments; the female flowers are very small and inconspicuous, like a little scaly stick about the size of half a clove stem.

How may we know the different oaks? Mainly by the form of leaf; sometimes by the form of fruit additional.

The scarlet oak has leaves in which there are about seven triangular, tapering, bristle-tipped lobes, and acorn cups nearly top-shaped and not large. It is common, mainly on the bottoms.

The black-jack is a large black-barked tree, not very tall; but broad and scraggly. The leaves have two broad lobes across the upper third of the leaf and a rounded base. The acorn cups are somewhat velvety. It is common on the hills.

The "water oak" often grows upon a high, dry hillside. The leaves on some particular trees are about the size and shape of a bear-foot track, rounded at the base and broad at the tip. Other forms are more pointed at the tip, like an Indian moccasin.

The post-oak leaves have rounded lobes, and are mainly in the form of a cross. Its acorn cup is velvety. It resembles the black-jack.

The bur-oak is an inhabitant of low ground; has very large leaves with rounded lobes, and large acorns that are almost covered by the very large fringe-margined cup. The acorn is edible.

The swamp white-oak has obovate or rhomboidal leaves, with wavy edges. The acorns are ovoid, with a neat well-formed cup. The acorn is sweet.

The chestnut oak grows on northern sides of rocky hills, in rather thick clumps or patches, making the trees grow tall and straight. The leaves are ovate or elliptic, with sharp teeth, and feather-veined. The acorns are rather small and sweet.

There is still another oak that does not grow in the woods, the scrub oak. This is a dwarf tree or shrub about 10 feet high, on dry rocky hillsides, in the open field. The leaves are similar to those of the chestnut oak; the acorns are very sweet.

Five species of hickory may be seen in the woods of eastern Kansas, namely: Pignut, bitternut, mockernut, shagbark, and big shell-bark. There are differences in these trees that may be learned; but, without specimens in hand, descriptions cannot here be made clear without the use of technical language,—except that pignuts and bitternuts have thin hulls, thin shells, and may be cracked in the teeth; edible hickorynuts are angular and have thick hulls.

Pecans grow in southeastern Kansas. Some of them have differences that seem to be as great as in the hickories; though whether those differences are permanent or merely local, remains to be told.

Black walnut grows to a great size in eastern Kansas, and to a good size in the western part of the State. The climate is perfectly adapted to the growth of walnut. In suitable flat spots not far from streams walnut may be found in groves to the exclusion of other trees.

Walnut trees do not bear transplanting. In planting a walnut grove it is necessary to plant the seeds four to eight times as thick as it is desired to have them grow. A better practice is to plant for the surplus trees cottonwood, peach, or other cheap and quickly growing tree, in order to force the walnut to grow upward in a single stem. When the walnut trees have attained sufficient height the cheap trees can be removed for fuel, as required, and the space left for the walnut trees.

Sycamore is occasional near streams, and grows to a good size. It makes a handsome park tree, and bears transplanting. With its smooth white bark, its numerous small pendent button-balls, its large leaves, with the frill-like stipules around the throat, its symmetrical mode of growth, and its freedom from insects, it is one of the most desirable trees for park planting, but it is not desirable to have too many, a very few specimens being enough for any park.

Very large sycamore trees are apt to be hollow. One of the memories of early boyhood is the gathering of maple sap and putting it into immense hollow sycamore logs preparatory to boiling. Somehow the ideas of sycamore logs and maple sugar are intimately associated.

Wild cherry is frequent on the hard land in the wood. It grows into trees 50 feet high. In the month of May it fills the woods with its great fragrance. Choke-cherry is occasional on the broken hillsides. It blooms a little earlier than the wild cherry. It is a shrub about 10 to 15 feet high.

A very interesting small shrub is the burning-bush, or wahoo, which grows along the bluff banks of water-

courses, with its green four-cornered branches, and its dark purple flowers growing from wood of the second year. Later in the season its 4-lobed capsules nod and hang in pretty fashion; and in the fall the capsules split open, showing the scarlet interior and the crimson seeds inside. A tree of this species, 9 feet high, a trunk two inches in diameter, a head perfectly symmetrical, nearly globular or conical in outline, four feet in diameter, covered all over with its elliptic green leaves and its tens of thousands of the dark purple flowers, was a most entrancing sight in June. In the fall, when the fruit was ripe and the capsules burst, showing the red seeds inside, the tree was a no-less-inspiring sight.

The honey-locust blooms in May, with its staminate and pistillate flowers growing on separate trees. Honey-locust is frequent in or near our woods, near watercourses. The foliage is exceedingly beautiful. Most of the leaves are pinnate; though some of the later ones are bipinnate, or partly pinnate and partly bipinnate. The blossoms on the male trees are very fragrant, and a great attraction for a certain kind of flies with a bee-like hum. The female trees are ornamented with many large branching thorns, as well as large, brown, somewhat-twisted, many-seeded pods. The male trees have very few simple thorns, or none at all.

Why does the fruit-bearing tree have thorns and the barren tree not? It must be a survival of a habit acquired in eons past, when the honey-locust fruit was edible, and wild men or monkeys were plentiful enough to eat all the fruit of the honey-locust trees, except of those that were so thorny they could not. Was it the fruit of this tree,

seasoned with wild honey, that John ate while in the wilderness? Locust plus honey equals honey-locust.

Coffee-bean is frequent in the wooded bottoms of the eastern part of the State, and is occasional as far west as Norton, Hays City, Ness City, and Syracuse; even forming small groves here and there on the creek bottoms of central Kansas. It is a most beautiful tree, not the largest, but well formed, with a straight trunk, handsome brown bark, and graceful branches. Its leaves are larger than those of the honey-locust, nearly two feet long, bipinnate, with 5 to 9 pinnæ or leafleted wings, about 11 or 13 leaflets to each wing or pinna. The leaflets are oval, about $1\frac{1}{2}$ to 2 inches long; sometimes, where there is a leaflet instead of a pinna, the leaflet is a little larger. The flowers are in terminal racemes, handsome, opening in May; the male and female flowers are largely separate, usually though not always on separate trees. The pods are large, thick, broad, brown, and pendulous; contain about five hard, tough-skinned beans each; and hang on the trees all winter, falling during the rains of April. The wood is soft, strong, and a light-reddish brown.

The last *tree* to bloom in the spring is the basswood, one of the most graceful of our forest trees, with its beautiful obliquely heart-shaped leaves, compact head, and its honey-laden perfect flowers. This tree is said to have two kinds of leaves; the wing of the seed resembles a leaf or a feather; it is not, however, a leaf; the tree has only one kind of leaf, and in this the venation and the toothed margins are beautiful; the leaves are rights and lefts, as in the elm. The tree is easily transplanted; and one or more in every lawn or park is desirable. It is a beneficent tree.

In the edges of woodland, or on steep rocky banks, about the last of May or first of June may be seen the round-leaved cornel or dogwood, a shrub 8 to 12 feet high, with broad cymes of white flowers, and later in the season white berries.

Along streams in hard land may be found another cornel, with similar flowers, and blue berries when ripe.

In the edges of woodland, and waste places in the fields, grows the shrub known as smooth sumac. It is a late bloomer. The foliage turns to a dark crimson early in the fall. Conspicuous on top of the branches may be seen dense spikes of crimson acid berries. A small portion of these berries put in with currants, apple, etc., in making jelly, will greatly improve the appearance and flavor of the jelly. Crabapple and grape jelly need none of it.

b.—VINES.

The woods of eastern Kansas are well filled with luxuriant vines, chief among which is the five-leaved ampelopsis, or Virginia creeper; though it ought to be called a "climber" instead; as it reaches the summit of the tallest trees of the ordinary wood. It belongs to the grape family, and climbs by tendrils similarly. But, unlike the grape, it adapts itself to circumstances; and when it cannot wrap its tendrils around the object, as a tree or a stone wall, it changes the tips of its tendrils into sucking disks, and adheres firmly to the bark of the tree or to the wall. The leaves of the Virginia creeper are in fives, and turn to a crimson red in autumn; and its broad pendulous panicles of blue-black berries are quite ornamental, and if gathered remain on the stems for a long time. They are not edible.

Climbing on the trees by river-banks there may be seen

another species of ampelopsis, with simple leaves and tendrils like a grape-vine. It strongly resembles a grape-vine. The berries are a dark greenish-blue, and not edible.

The grape itself is one of the most conspicuous vines of the woods. It is able to climb the tallest trees of the low woods. The stem of the vine occasionally attains a diameter of eight inches. The dark wood of the vine is beautiful in some forms of cabinet work. The grape is noted for the great fragrance of its blossoms. The fruit is an added attraction.

The climbing ivy is another vine that loves to climb tall trees. It clings closely to the bark of trees and clothes the naked trunk with pleasant foliage. The leaves are three-parted. Like the Virginia creeper, its foliage changes to a gorgeous red in the fall. Only this red is more of a scarlet; while that of the Virginia creeper is more of a crimson. The berries of this species are white. Its reputation for being poisonous, like all bad reputations, has greatly outrun it. The tall forms, that climb high, are not at all dangerous; though the low non-climbing forms sometimes appear to poison people by contact, especially when a person is hot and perspiring freely. All who fear it should avoid it.

The greenbrier is a frequent vine of low woods. There are a number of different species, some exceedingly thorny, some scarcely thorny at all. All have beautiful leaves, ovate, heart-shaped, or halberd-shaped, with entire margins and parallel veins. Each leaf is supplied with a pair of tendrils and usually a handsome cyme of green-black berries. The greenbrier thorns are not in themselves poisonous; but, if one allow the skin to get scratched by them, then there is danger of getting poisoned by many

of the poisonous plants that under other circumstances would be inoffensive.

Moonseed is a frequent vine in sandy woods. It has very handsome foliage, rather heart-shaped, with about five points around the margin of the leaf. It grows to a height of 10 to 12 feet. Its male and female blossoms are on separate plants. The berries are bluish-black.

One of the most ornamental vines of the margins of woodlands and of shrubby patches is the climbing bitter-sweet. It loves to climb bushes. It has ovate leaves, smooth and somewhat shiny; its fruit is in terminal racemes, coming out and showing above the leaves. The capsules are triple; and, when ripe in the fall, burst open, showing the bright orange interior and scarlet seeds, which will remain thus all winter or for several years, if gathered for ornament. The flowers and fruit resemble closely those of the burning-bush, before spoken of in this chapter.

The berries of these vines, except the grape, are all ornamental; and for ornament provide a great variety of colors. The berries of the Virginia creeper are a bluish-black; of the ampelopsis are a dark greenish-blue; of the climbing ivy nearly white; of the greenbrier a greenish-black; of the moonseed are a bluish-black; bittersweet scarlet; and burning-bush crimson.

In thickets along creek-banks, by the edge of woodlands, grows a vine of the milkweed family that climbs bushes to a height of six or eight feet. The vine has opposite cordate leaves, with a deep round sinus at the base and clusters of small fragrant flowers in the axils. The fruit consists of two erect follicles, as in the milkweeds. It is called milkweed vine.

The wild cucumber is frequent in the rich alluvial soils

of our low woods, and in similar soils in brushy creek bottoms all over the State. It is an annual, starting from the seed even before danger of frost is past; and by means of its tendrils quickly covers a bush 10 to 15 feet high with its luxuriant and handsome foliage. The young plants can readily be transplanted. The seed leaves are large, almost like those of a pumpkin. If planted by, or transplanted to, a trellis by the house, it is liable to be destroyed by the common squash-bug, cucumber-bug, and other hemiptera. The foliage has five sharp points, somewhat like a maple or the sweet gum. The inflorescence is somewhat poisonous, and cannot safely be touched by delicate hands.

And last, but not least, we come to the crowning glory of the season—the climbing prairie rose. Other flowers may be more gorgeous and brilliant, others more fragrant, others more interesting, other fruits more ornamental; but there is no flower that combines the beauty, the fragrance, the sweetness, the homelikeness of the rose, or anything to equal it.

C.—HERBS.

In March or early April, on dry, rocky, and wooded hillsides adjacent to streams, in the eastern part of the State, and not infrequently in the immediate neighborhood of a snowbank, may be found the pretty little bloodroot,

“Wrapped like a soldier in his cloak,
Upspringing from the damp, dark mold,
Wakened by southern winds, there blooms
A snowy flower with heart of gold.
But they who seek the early flowers
In woodland nook, by field and flood,
Forbear to gather these, because
Their crushed stems stain the hands like blood.”

A single palmately lobed leaf, several inches high, arises

from a horizontal underground rootstalk, followed by a single flower on a scape or stem two or three inches high. The flower has eight or ten white petals surrounding about 20 to 24 yellow stamens. Later the scape and capsule are overtopped by the leaves. The juice of the rootstalk is orange-red, whence the name.

In shady spots in early April may be seen numerous lily-like spotted leaves, about four to six inches long and one to two wide, rising singly from the ground and giving promise of a future flower. It is the white adder-tongue, a liliaceous plant; but flowers are seldom seen.

On open hillsides, especially northern slopes, in grassy lands, may be seen plenty of similar leaves, usually two at a place, much narrower and unspotted, and each two carrying a scape with a nodding, white, lily-like flower, more slender than the other, but otherwise similar in appearance. This is the Midland adder-tongue, as named by Prof. Knerr, of Atchison. Owing to their time of blooming, the children call them "Easter lilies." Wherever the leaves are single, there is no flower, similarly to the white adder-tongue.

In rich well-drained spots overhanging streams, and otherwise near streams, may be seen, four or five inches high, the soft, finely divided foliage and nodding racemes of little heart-shaped pink flowers of "Dutchman's breeches," those little fairy garments that are hung out on the lines in early spring, as soon as the snow has disappeared. Those pale and fragile flowers are the nymph-like sisters of the "bleeding heart" of the gardens; but in this case they have the added charm of fragrance.

A plant somewhat similar in appearance, but lacking

much of its delicacy and fragrance, and growing on dryer grounds, is the golden corydalis. The flowers are irregular, and furnished with a spur half the length of the flower. The sharp and bitter taste of the plants, the number of parts of the sepals, petals, and stamens, and the 2-valved pod, place this plant very close to the mustard family; the form of seed seems to link it with the poppies.

Early in April, in moist shady woods, near streams, the children take great delight in the abundance of wild "blue" phlox. The color of the flowers ranges from violet, through heliotrope and mauve, to a pale lavender. They are sometimes white. The old folks call it wild sweet-william, on account of its close resemblance to the sweet-william of Eastern gardens. It is pleasantly fragrant, and so pleasing in appearance that it will form the principal flower in the early spring bouquets of most children.

A noticeable plant in rich woods, growing 10 to 12 inches high, with three 3- to 5-parted and toothed leaves, surmounted by an erect raceme of pink or white mustard-like flowers, is *Dentaria*, or toothwort; sometimes called, on account of the sharpness of its root, pepper-root. It is rather a coarse, weedy-looking plant; and, were it not so early, when handsome flowers are rather scarce, would not be noticed.

The blue hood-leaf violet of the wood is always eagerly looked for by the children, and is a great favorite with them. The girls will look the flower in the face and tell you the story of the cruel stepmother and her daughters, the poor old man in the midst; yes, and show you all the people there in the flower. With the boys the flower is the emblem of success; the boy who can find a violet that in

playing "rooster" will snip off the heads of all the other boys' "roosters" (violets), when interlocked by the spurs, is the boy who is going to succeed.

The yellow wood-violet comes a little later, and has its flowers on the stem of the plant, instead of rising from the ground as does the blue violet. It is much rarer than the other; but it lights the open woodland with its glow, inspiring the poet's fancy—

"Thy parent sun who bade thee view
Pale skies, and chilling moisture sip,
Has bathed thee in his own bright hue,
And streaked with jet thy lower lip.
Yet slight thy form and low thy seat
And earthward bent thy gentle eye,
Unapt the passing view to meet
When loftier flowers are flaunting nigh."

About the first of May, or a little earlier, may be found in certain shaded spots an abundance of "May-apple." This rises from an underground stem several years old. The first year from the seed the plant is only one or two inches high, surmounted by a peltate leaf having only two divisions. The next year it is more than twice as high and has twice as many divisions to the leaf. The third year the leaf-stem reaches full height, 10 to 16 inches, and has the full-sized umbrella-like leaf, with eight double divisions, from which the plant receives the name of umbrella-leaf. The fourth year, sometimes the third, according to the vigor of its growth, the forked stem appears, bearing in its axil the waxy-white, odorous blossoms, shaded now by two umbrellas, though each is torn on the side toward its mate, as though originally the one umbrella was cut in two and the top of the stem also to a depth of three or four inches; then the divided stems had healed up and the half

umbrellas had spread around until each made as near a whole umbrella as a split umbrella could. The flowers are favorites for May-baskets, when the leaves are removed, and they are massed in a setting of fern fronds to bring out their beauty. The fruit is edible when fully ripe; though one must acquire a taste for it in order to be able to safely eat more than one or two. The "apples" ripen nicely by gathering them when fully grown, if not quite ripe, and packing them in dry meal or bran for a few days. When fully ripe they are yellow and soft. Only the seedy inside is edible.

In the margin of the wood, in sheltered spots on the low prairie, we find the blue larkspur, a reminder of the flowers of the garden, and seemingly an escape. Royally colored as they are, the spikes of this flower make a rich color note in the spring landscape.

On the sides of steep, rocky, wooded bluffs, overhanging a river, in an apparently inaccessible place, in May, appear the nodding blossoms of the wild columbine, with the long vertical spurs of the flowers well filled with nectar for the insect that can succeed in reaching it. That is not the honey-bee, though the poets so imagine.

"Fair herald of the race of flowers,
Daintiest of all the springtime knows,
Fresh with the chill of April showers
Or breath of late dissolving snows;
The secret places of the rock,
Wherein no human foot may stand,
The overhanging rock that mocks
The bravest climber's reaching hand;
The inaccessible ravine,
Shadowed and dewy all day long,
Where at the bottom, dimly seen,

The unsunned brook repeats its song ;
The cliff unscaled by daring feet,
The glen concealed in twilight gloom —
These offer thee their safe retreat,
And look upon thy hidden bloom.
Thou lov'st to climb the highest rock,
Seamed by a finger's breadth of soil,
And thence look brightly down, and mock
The lover who would seize and spoil."

In the damp, rich woods, in June, may be found a hairy plant, called waterleaf, 10 to 12 inches high, with leaves palmately 5-lobed, and cymose clusters of small pale-blue flowers. The flowers are usually of two kinds—one, with short stamens and a very long style; the other with shorter style and very prominent stamens.

In shaded, sandy spots along rivers may be seen a liliaceous plant, about two feet high, with alternate ovate leaves, surmounted by a raceme of white flowers, followed later by a few pale-red berries. This is the little Solomon-seal, so called because of the stem-scars on the underground root-stalk.

In similar situations may be found the great Solomon-seal, a somewhat similar plant, two to four feet high, without a terminal raceme, but with small clusters of flowers in the axils of the leaves, followed by small dark-blue berries. This plant grows nearly all over the State, at least as far west as Ellis and Garden City.

On bushy banks of streams may be found the very handsome blue lettuce, a plant three to six feet high, with panicles of blue flowers that open in the morning and close about noon. This also grows as far west as Almena, Ellis, and Garden City.

On moist, steep hillsides, close to a stream, grows Cam-

panula, the American bell-flower, a slender, erect, leafy plant, three feet high, with star-shaped, campanulate, blue flowers, one inch across. The plant, in color and size of flower and general appearance, resembles blue lobelia.

In August, on wooded hillsides, white snake-root, a weedy-looking plant, two or three feet high, with bushy top and white corymbs of composite flowers, is very conspicuous in its great profusion. The masses of clustered blossoms fill the autumn woods with beauty.

The wood-asters will end the season, or at least end this census of wood flowers. The wood-asters are many, and of many shades of color, from a deep purple through blue to white. The leaves are soft, and always more or less heart-shaped; at least they have heart-shaped bases, though otherwise the leaves may be rounded, or ovate, or arrow-shaped, or lance-shaped. The character of the flower corresponds in all cases with the character of the leaf. This is true, in the main, not only of wood-asters but of all plants.

4.—PRAIRIE FLOWERS.

May and June are the great flower months in Kansas. During the spring months there is no place more beautiful or more interesting to the passer-by or the botanist than the prairies of Kansas. The abundance, beauty, and size of many of the flowers cause certain spots to rival some of the showy Eastern flower gardens.

From the marsh to the low prairie is but a step. There are many plants common to both situations; and many plants that grow in wet meadows here may be found growing in dryer meadows farther east. Only the most common ones peculiar to the region will be mentioned here.

a.—APRIL FLOWERS.

On dry prairies, high or low, one of the earliest little plants to catch the eye with its little raceme of small white flowers is the little draba, a winter annual with a pretty rosette of small ovate or spatulate leaves on the ground, and a starry pubescence on stem, leaf, and pod.

Along the waterways, in the low grounds, the wild hyacinth catches the April winds. Graceful and with delicate coloring it has won its way into our gardens.

The field violet is a favorite of the prairie. Unlike its sister of the woodland, it grows singly, not in groups, and loves the bright, glad sunshine. How does it differ from the wood violet? By its leaves, which are of the same general outline, being all gashed and cut up into ribbons, as though done by the fierce winds of the hillsides; by the large, bright purple, hairy flowers, as though the plant, seeing its end near, was prepared to yield its life to produce,—which is almost literally true; for the plant, its seed ripe in May, can be seen no more, once the hot weather of June is at hand.

A very similar plant is the bird-foot violet, with similar leaves and flowers, and growing, about a month later, in similar situations. But this plant appears more like a pansy, has smooth petals, varying from a dark purple to a pale lilac, or even white, and with the upper petals usually darker than the lower. It may occasionally be found in bloom a second time in autumn.

Next we find the field pansy, seeming to choose certain spots that have a rich, damp, sandy soil, and having flowers that are each one, two, or three colors, or shades of colors, between violet and yellow. It has small roundish leaves,

on long petioles, ornamented by a pair of very large laciniate (deeply gashed) stipules, even larger than the leaf. The stems are tall and branched; the flowers numerous, and the seed-pods conspicuous, when ripe, toward the last of May or early in June.

The trailing verbena is to the children of the prairie what "daisies and buttercups" are to the children of the East. It is perennial in life and almost perpetual in habit of bloom. It comes early and stays late. Scarcely have the last snows of April disappeared when its clusters of bright-red tubular flowers may be seen peeping above the young grass; and the first snows of fall will sometimes find it blooming still. Its fragrant blossoms have wreathed many a ringlet-crowned head; and twined wreaths are even now reposing in old school-books, faded and odorless, but recalling happy childhood days.

Prairie peas are quite numerous and abundant; all blossom in April and May. Among the first is the common "buffalo pea." The blossoms vary on different plants, through all shades, from a pale straw-color to a rich crimson. They all change to yellowish in fading. The fruit is somewhat edible when young and tender. It is occasionally used as a substitute for green peas or asparagus. It is said by frontiersmen to possess powerful pectoral properties, clearing the throat and making the breath flow freer. The fruit, when ripe, resembles, in color, shape, and size, a shell-bark hickory-nut, but is very light and corky.

A similar plant, blossoming at the same time, is the ground plum. The color of blossom is about the same, with nearly the same variations. The habit and general appearance of plant and leaf are also much the same, and

the plants are very apt to be confounded in the herbarium. An intimate acquaintance shows recognizable differences. In the latter, the stems, at the base, are smaller, harder and darker, and are more prone to cast root at the joints. The leaflets are a little more slender, and the pubescence (what little there is) is sparser and more closely appressed. But the fruit, when ripe, differs greatly. The pods are much smaller, harder, have a deep suture on the under side, and a hard, sharp, upturned point.

Toward the last of April, on the dry prairies of middle Kansas, growing singly and far apart, may be seen stems of yellow indigo, about a foot high and bending over the grass with large racemes of coarse-looking yellow flowers, usually more or less gnawed by insects. They are sometimes collected for a bouquet, but are not especially handsome.

The very pretty pink sorrel, with its large nodding violet-pink blossoms, comes into bloom toward the close of April. The scaly bulbs, as well as those of the wild onion, are the favorite article of food with the striped prairie squirrel.

A very pretty and early bloomer is the wild-pea vine. In some favored, damp places, it grows so as to completely cover the ground and grass, and with its bright bluish flowers make a handsome bed.

On the dry prairies there is a sort of wild dandelion with long, wavy-edged leaves. The flowers resemble the old-fashioned dandelion in many respects, and, like that, close in the evening and in damp weather.

Abundantly, in some spots on the prairie, we find the wild onion, with its pretty clusters of pink star-shaped

flowers, six inches high. The flowers have the odor of, and much resemble, garden pinks, though care and handling is necessary, so as not to crush the plants, or the odor instantly changes. These have terete hollow leaves. Later, a taller kind, twice the height, with white flowers, and flat, carinate leaves, appears. The flowers have not the pleasant pinky odor of the others; but the garlicky odor is stronger. There is a species intermediate in height between these two, with white and pink striped petals, and semi-terete leaves, channeled on the upper side.

These flowers, gathered into a bouquet, are almost everlasting in form and color,—and have an everlasting smell, too. There is a tall species, eighteen inches high, in moist places, that has bulbiferous umbels.

These onions all have reticulated, fibrous bulbs. Cows are fond of the tops in spring, to the detriment of the butter. The bulbs form a large part of the food of the prairie squirrel. The low pink variety is worth cultivating, and would make a very pretty border in a flower garden early in spring.

On the hilltops and dry prairies in early spring may be seen many Carolina anemones, growing singly, about six inches high, from small round tubers. The root-leaves are 3-parted and each of the divisions 3-cleft. Half-way up the stem is a small involucre (large for the size of the plant) of three leaves, each 3-parted, and the divisions 3-cleft, making apparently nine 3-cleft leaves in a whorl. The flower at the top has normally about 13 colored sepals, the colors being purple, blue, pink, rose-color, or white, and various shades of those colors. Altogether it is a very pretty flower.

b.—MAY FLOWERS.

One of the most showy flowers of the prairie is the crimson poppy-mallow (*Callirrhoe*). This is a vine, four to eight feet in length, running on the ground, and having large, bright crimson, white-centered flowers, that open in the morning, remain open all day, and close at sunset or earlier, to reopen next day for a time or two. The flowers change to a purple in drying. The leaves are rounded, with rather deep sinuses; the flowers are single, one at each leaf axil, on peduncles six or eight inches long, raising the flowers above the grass and slightly above the leaves of the plant. The plants bloom from May to July. The root is perennial, large, somewhat parsnip-shaped, abounding in mucilage, and eaten by Indians.

Another mallow of damp prairies (a *Callirrhoe* also) has smaller (perennial) roots, weak stems 18 inches high, and pink flowers, with beautifully fringed petals. The flowers are solitary, in the axils of the upper leaves. The leaves are triangular, the lower ones almost entire; a little above they are strongly crenate; and the upper leaves, still triangular in outline, are three- to seven-parted, the segments variously lobed and cleft. Either of these is worthy of cultivation, and capable of it.

About the middle of May the handsome spiderwort comes into bloom. It is abundant everywhere, especially on the low prairies, and is one of the most noticeable flowers of the prairies. The flowers vary, through all shades of purple, from a very pale blue to a bright rose-color. The extremes are not often found, and pure white ones are rarely found, though white ones with pink stamens sometimes appear. They are to be found quite double. They are, no doubt, capable of much improvement by cultivation.

On ground broken by gophers, and on new "breaking," we find the elegant little scarlet gaura, ten or twelve inches high. Its flowers, when first open, are white, soon change to rose-color, and finally to scarlet before fading. It is one of the very few pleasantly fragrant prairie flowers.

A feature in this Western country is the very showy and really splendid great-flowered evening-primrose. The plant is low and insignificant. The flowers open at a time of day when most other flowers are closed for the night, and next morning have lost their brilliant color; otherwise they would be admirable. Spots that in the spring were all pink and blue and white with anemones and wild onions, in May are purple all day with poppy-mallows and spiderworts, and yellow all night with evening-primroses.

In the alluvial lands of Neosho and other southeastern counties, occurs the "wild potato vine," a species of trailing morning-glory vine from a stout perennial root, called, like other roots of the same and other families, "man-of-the-earth." The vines have broad cordate leaves and red-purple or white flowers that open very early in the morning and close after noon.

On the low prairies, in eastern Kansas, about the last week in May, may be found plenty of Pennsylvania anemone, a plant with plenty of foliage and numerous branches, each terminated by a flower with five broad white sepals. The involucre on this plant consist of two leaves each, with each leaf 3-parted.

The "red-root" or Jersey tea is an abundant shrub in dry prairies and rocky situations. If this plant was not a favorite in Revolutionary times, its appearance deceives; for each of the petals, which rises on a little claw, tries

to cover the pistil, and is shaped just like Israel Putnam's three-cocked hat of old.

There is a handsome half-shrubby evening-primrose, with numerous yellow flowers, one and one-half inches across when fully open, though at first the four petals look very crumpled. This crumpling is a beauty in itself, as it differs so much from the character of any other flower. The stigma of this flower differs from all other evening-primroses in being discoid, with four notches.

On moist prairies there are several species of allionia, a sort of wild four-o'clock, about two feet high. The most common kind in the eastern part of the State has heart-shaped leaves, and crimson flowers that open at four o'clock in the afternoon. Several flowers in succession, one each day, opens within the same five-pointed, salver-shaped involucre. Each flower produces one small black, barrel-shaped seed. When the seeds are ripe, they stand on the broad involucre like so many black inverted goblets on a tray. The plants are common in the parks of some of the towns and on sandy islands of the rivers.

The white allionia is frequently met with on sandy prairies. It has long narrow leaves and slender white flowers. Its flowers open in the evening.

Common on the prairies and valley lands grows the prairie June-grass, a grass that ripens in June and reaches the height of 18 inches. It is a desirable grass and can readily be cultivated from the seed.

Abundantly in rocky places, in May and June, may be seen the tall white larkspur, with its slender wand-like stems, about three feet high, and its curious long-spurred whitish flowers, with black anthers set in the woolly throat.

Its leaves, most of which are basal, are finely divided; those of the stem are few and small.

Common in May and June, in eastern Kansas, on dry or slightly damp grassy prairies, may be seen the brilliant crimson cymose panicles of the downy phlox, just appearing above the grass. No one who is gathering a bouquet of prairie flowers will pass them by. They are good keepers.

Common in rocky situations on the prairie, rarely in the edge of woods, may be found two species of great-flowered pentstemon. One has smooth and glaucous leaves, numerous short branches, each bearing one to several large, thimble-shaped, bluish-white flowers; and the other has rougher leaves with sharp teeth on the margin and very large purplish flowers in panicles similar to the first. Each grows about 18 to 24 inches high, with panicles fully a foot. They are favorites for decoration purposes on Memorial Day, as they are gorgeous in appearance and great keepers. They grow from perennial roots.

On rocky hills, anywhere in eastern Kansas, about the close of May, from large, strong, fibrous and starchy perennial roots, grows the Missouri evening-primrose. The stems are about 12 inches long, weak, mostly lying on the ground and rising slightly. The leaves are 3 inches long, thick, leathery, smooth on the margins, broadly ovate, varying to lance-ovate, and covered with a very fine silky covering of dense short hairs. The flowers open at 7 in the evening, with calyx tubes five or six inches long and yellow flowers four or five inches across. The seed capsules are on very short stems, one at each leaf, about 2 to 2½ inches long, straw-color when ripe, and with four remarkable

wings, at the sutures between the valves, an inch in breadth and standing out at right angles to the capsule. The wings, then, are each double, like two leaves of a book folded together, and when dampened a little separate and allow a few seeds to escape. They close again when dry.

On the high prairies of the State yarrow is common. It seems to be a native, as it is found common in the remotest parts. Its handsome corymbs of white heads, its finely divided foliage, and its peculiar agreeable odor, seem to be just like the yarrow of our Eastern gardens. Pink yarrow is occasional.

C.—JUNE FLOWERS.

Early in June, in sandy spots, may be found in abundance the very interesting day-flower, growing on low, jointed, grass-like plants, with beautiful deep-blue flowers, having two petals only, the third suppressed, a mere rudiment being just visible. Curiously enough, the three stamens opposite the perfect petals are barren, and furnished with yellow cruciform glands instead of anthers, while the three stamens opposite the abortive petal are fully developed, and have large purple anthers. The long style bends down to meet the incoming insects carrying pollen. The flowers are very delicate and short-lived.

Yellow sorrel is quite pretty and abundant in spots in June. This plant has a stem, while its more showy sister, the pink sorrel, must be content with a scape from a bulb.

Common on the prairies of eastern Kansas is what is known as "leather-root," a semi-shrubby plant, three feet high, with many branches and surmounted in June with many racemes of purple pea-blossoms. The upper leaves are 3-leafleted, the lower have five, rarely seven leaflets.

The leaves and whole plant are covered with minute transparent and black dots; the plant has a somewhat resinous odor, and the roots are small, yellow, fibrous, tough, and exceedingly long.

On low grassy prairies, in the eastern two-thirds of the State, in June and July, may frequently be found little clumps of star-grass, with numerous flat or two-winged stems, eight inches high, having at top a small cluster of white rarely blue 6-parted flowers, the breadth of the thumbnail, usually blooming about one a day from each cluster.

On the prairies of middle and western Kansas, and the rocky hills of eastern Kansas, appears the very interesting sensitive brier. This has weak stems or vines, two to three feet long, leaning on the grass or on the ground. The stems, petioles, peduncles, and pods are well covered with curved prickles. The leaves are bipinnate, with about six pairs of pinnæ. The leaflets are very small. When the plant is touched, the leaflets close together; sometimes the pinnæ also partly close. The blossoms are very small and numerous, packed closely into a compact globular head. The petals are so small they are unnoticed; the stamens are longer, pink, and stand out in all directions from the head like the hairs on a bottle-brush. But the flowers, aside from their thorns, have a most sweet and delicate odor. The pods are three inches long and have four valves.

On the dry prairies of eastern Kansas the large white indigo (*Baptisia*) is frequently seen. It grows in stems one or two from a perennial root, is about four feet high, and commonly has a nodding terminal raceme nearly eighteen inches in length with many large white flowers standing upon the leaning stem. The foliage is trifoliate

and a handsome bluish-green color; the flowers are too large and coarse to be handsome, except at a distance.

d.—SUMMER FLOWERS.

On ground that is partly broken, occasionally may be found an abundance of wild lettuce, growing tall and straight. The small flowers are in large panicles, and open at 8 o'clock in great profusion and close about 11, thus showing no flowers for most of the day. The colors of the flowers on the different species are straw-color, yellow, orange, salmon, and scarlet.

In buffalo-wallows, and other water-holes and low spots on the high prairies, grows an abundance of showy coreopsis. This is really a marsh plant, though it grows on the high prairie; for it is to be found only where the water stands a portion of the time. The plant is about 3 feet high, with pinnately divided leaves and about eight yellow rays with brown bases, similar to the garden coreopsis of the East and probably the ancestor of it. It is handsomer than many garden plants.

Common on the prairies, in the middle of July, may be seen the prairie-clovers. There are two species—the crimson and the white. These prairie-clovers stand about two and one-half feet high, quite erect, and sometimes branched a little at the top. Each branch is terminated by a compact spike, one to two and one-half inches long, terminating the main stem and each of the few branches. The earliest flowers open in a circle at the base of the spike; then the inflorescence gradually works upward. There are no regular petals, as in flowers of the pea family usually; but the odd stamen at the top is converted into a cordate banner, and four of the nine stamens below are converted

into oblique oblong petals, leaving only five stamens. The white prairie-clover has five to seven small leaflets, and the crimson has the same number of very small, almost minute, leaflets which readily fall off in drying.

In clumps scattered here and there over the dry prairies, the orange-red butterfly-weed, a low plant of the milkweed family, gleams amid the grasses as the banquet table of the butterfly.

On the outskirts of the low prairie, close to the timber, in the very eastern part of the State, may be seen the wild lily, rivaling in color the tiger-lily of the gardens, its rich spotted petals showing where the tall meadow-grasses almost hide it.

On the moist prairies of central and eastern Kansas, in July and August, grows a form of salvia, with erect stems, four or five feet high, and a brilliant raceme of deep-blue flowers. This is a plant that ought to be called wild sage, but is not. It is one of the representatives of the sage or salvia family, that grows on the prairies. The flowers are typical salvia flowers, with two lips, and the two stamens and pistil ascending high under the upper lip and partially concealed there. The plant is rather strong-scented. White flowers are occasionally found.

On dry prairies of central and eastern Kansas grows *Ruellia*, a little plant about two feet high, with hairy ovate leaves and irregular tubular flowers, resembling somewhat the petunia. The flowers are reddish, open early in the morning and drop off in the middle of the afternoon.

In July and August, on dry prairies and those moderately low, numerous plants of *Cassia*, or sensitive pea, may be seen. It is a plant about two feet high or more, with pinnate leaves, yellow, single, regular flowers, and

five perfect stamens with black anthers. The leaves, which have each about 20 to 30 pairs of leaflets, are sensitive to the touch, but do not close immediately; though they do in a short time. The leaves revive and spread when the stem is placed in a vase of water.

On the bottom lands of eastern Kansas may be found in abundance the prairie acacia, a plant of the sensitive-pea kind. It stands erect, about three feet high, with numerous bipinnate leaves and exceedingly small leaflets. The leaves do not close immediately upon being touched, but close in a very short time, when the plant is cut and put into a bouquet in lieu of fern fronds. However, when allowed to rest in a vase of water they open again and are beautiful, with their very fine foliage. The flowers are white and similar to those of the sensitive brier, to which the plant is closely allied. The pods are short, brown, curved, in a compact cluster, and with 3 or 4 beans in a pod.

e.—AUTUMN FLOWERS.

Everywhere on the prairies grow the many species of goldenrod, with very rich, odorous golden plumes nodding in the breezes.

Common on the prairies, both high and low, from black, fibrous, globular, perennial tubers, grow a number of different species of blazing-star and button-snakeroot, as some of the species are called. The plants are from 18 inches to five feet high, with numerous linear or spatulate, rigid, dotted leaves, and conical, top-shaped, cylindrical, hemispheric, or globular heads, arranged along the upper part of the stem either singly, at each leaf-axil, or in a compact spike terminating the stem. The heads are rayless. The flowers are crimson, purple, or white. The white pappus

is mostly plumose. Some of the species are called gay-feather.

A weedy-looking series of plants of eastern Kansas is that called boneset and thoroughwort. They are 3 feet high or more, have opposite leaves and panicles of very many small rayless heads. The flowers are white or purple. These weeds are conspicuous features in the open woods or on the low prairies.

A showy flower on the eastern prairies in the fall of the year is the many-flowered aster, a plant reaching a height of about a foot from the ground, with many branches and branchlets well covered with very many small white aster heads, that remain in bloom for several weeks.

On gumbo lands all over central Kansas grows the annual sunflower, reaching, in alluvial soils, sometimes, a height of 15 feet, and usually growing to the height of six to eight feet, with numerous branches, and the regular sunflower head terminating each branch. These sunflowers are the golden glory of the State, one of the most conspicuous features that reach the eye of the traveler in passing through the State.

On the prairies of eastern Kansas, in the fall of the year are seen, here and there, a single flower, or a small clump, of the beautiful blue gentian, the crowning wonder of the prairie's beauty, to whom the lines of Bryant will apply:

“Thou waitest late and com'st alone,
When woods are bare and birds are flown,
And frosts and shortening days portend
The aged year is near his end.
Then doth thy sweet and quiet eye
Look through its fringes to the sky,
Blue—blue, as if the sky let fall
A flower from its cerulean wall.”

5.—SAND-HILL VEGETATION.

The vegetation of the sand-hills is such as can endure considerable extremes of heat and cold, strong winds, evaporation, and beating with sand; but does not necessarily have to endure considerable drouth. The sand-hills are nearly always supplied with some moisture and never overburdened with it; so that plants growing here find themselves in a more uniform habitat than under almost any other existence.

a.—SPRING BLOOMERS.

Conspicuous in such locations is to be seen the sand-plum. This is a shrub from one and one-half to eight feet high, tough, gnarly, and with slender leaves, and fruit that rivals in size and flavor the common wild red plum of the East. The fruit varies greatly. The plums are of all sizes, from the size of the egg of a prairie-chicken down to that of a large bean, and the colors vary from yellow, through all shades of orange to nearly a bright red and even a purple or bluish. The pits are smooth or furry, nearly globular or flattish, and with or without a distinct crease running down one edge of the pit. The fruit varies from sour to a delicious sweet; and it often happens that a very desirable variety may be found in abundance on certain bushes, while other bushes, near by and growing in precisely similar situations, bear only undesirable fruit. The fruit is almost entirely free from the attacks of fungi or insects. It is decidedly the hardiest of all our plums, and by careful selection varieties ought to be raised under cultivation that would be desirable. The raising of these plums, under cultivation, in a soil and climate foreign to their natural

habitat, may not be attended with success; but that is a matter for the future to determine. The skin of the fruit is very thick, which, undoubtedly, accounts for its immunity against curculio and other insects, and protects it from fungi.

Another plant, that is quite conspicuous on sandy wastes and rocky hillsides, is the narrow-leaved yucca, or Spanish dagger, as it is called. The stem of this plant is about three inches thick and no more than four inches high, and is covered with a dense growth of leaves, about 18 inches in length by two-thirds of an inch in breadth, standing straight out from the plant in all directions. Each plant thus makes a conspicuous object that may be seen for miles. Its numerous long, narrow evergreen leaves are charming in the winter when everything else has turned brown. The leaves are frequently used by hunters as cords to hang up meat. The roots are about two inches in thickness and very long, extending underground from 30 to 100 feet. They are believed to have burst rocks asunder by constant growing pressure. The root of this plant is called "soap-root."

A soap manufactory was established some fifteen years ago in Wichita for the purpose of making a valuable toilet soap of the roots of this plant. The material was obtained partly from western Kansas, but in greater quantities from northern Texas.

The yucca blooms in May and June. In May a panicle rapidly shoots up to a height of three feet, and bears numerous cup-shaped flowers two inches in diameter, having 6 creamy-white and leathery sepals, with 6 spreading stamens and a stout 3-parted pistil, followed by a 3-sided

green capsule 3 inches long and $1\frac{1}{2}$ in diameter, containing 3 double cells or carpels, each cell containing about 50 thin flat seeds, black when ripe, and packed as closely as possible. Fertilization of the flowers is effected by a special insect called the yucca moth, which stings the soft young capsule and deposits eggs. The soft growing seeds form the food of the resulting larvæ.

Two species of pentstemon, twelve to eighteen inches, are found in very dry sand-hills, both with very glaucous, waxy-looking, entire leaves, one with handsome white or pinkish blossoms, the other with large, beautiful blue blossoms.

Two other plants that are very conspicuous in the sand-hills and other dry hillsides, are the common loco weeds.

One is the woolly loco, forming a large clump of pinnate leaves, like a pea-plant, only having more leaflets to each leaf. The numerous stems of this plant are about two inches high, but the leaves reach up into a dense cluster, 8 to 14 inches. The stem and leaves are covered with a dense woolly pubescence. It blooms in May, with somewhat inconspicuous, yellow clusters of flowers.

The other species of loco that is most conspicuous is called Lambert's loco weed. It has stems about 8 or 10 inches high, with slender, slightly woolly, leaves; having, like the other, very many small leaflets, and often growing in dense tracts on the sandy hillsides. When in bloom, from the 1st to the 10th of May, with its bright, crimson clusters of flowers, it changes a sandy hillside into an immense floral mound.

Both of these plants are said to be poisonous to stock. Ordinarily, cattle and horses do not eat the plants; but,

perhaps, when driven to it by scarcity of other food, they do eat them. The stories that have been told relative to the wonderful inebriating effects of these plants upon stock need to be carefully weighed and properly considered. The reputation that the plants have for making cattle and horses "crazy" may be far beyond the just deserts of the plants. Perhaps lack of water, after all, may be the principal cause.

b.—SUMMER BLOOMERS.

A conspicuous plant that is very common in the sand-hills, in summer-time, is the hairy golden-aster. This plant grows to be about 2 feet high, with branching stems, small ovate, hairy leaves, and conspicuous, golden-rayed heads, resembling small sunflowers, except that the center is yellow instead of brown.

A common plant of the sand-hills of western Kansas is the sweet-scented abronia. It grows in low clumps on the ground, and opens its large, trumpet-like blossoms just at sunset. The color of the flowers is a reddish purple, not only very showy, but very fragrant.

A plant of the sandy ranges, that blooms late in summer, is the graceful little *frelichia*. It is a tall, slender, jointed plant, 2 to 3 feet high, very woolly on the stem, and with few branches and small hairy leaves and small pink flowers that are followed later by cottony seeds, in which the cotton remains exposed for a long time, giving the plants white heads.

Mountain mint is a common plant of the sand-hills. It is about $2\frac{1}{2}$ feet high, with handsome aromatic heads of pink flowers.

A plant of sandy plowed fields, rather than of the sand-

hills proper, is the sand-hill sunflower. This differs from the common annual sunflower, which it most nearly resembles, in having narrow leaves, in being less erect and less rough, and in growing to less than half the height of the common sunflower.

Another plant (a grass) of similar locations is sandbur. This, when cut quite young and tender, makes very good hay; cattle and horses eat it freely. When the burs are allowed to harden before cutting, it is cruel to feed it to stock.

A conspicuous plant of the cultivated sand-hills is the sand-hill tumble-weed. It has very small leaves, and seeds like a winged wheel. Like the Russian thistle, it requires cultivation to bring it to perfection. Commonly on the prairie the plants rise to be about four to six inches high, with one or two small branches, one or two inches long, and bearing in all perhaps half a dozen seeds. In the sand-hills near the river, where the land is cultivated, the writer has collected them over five feet across and about $2\frac{1}{2}$ feet high, with hundreds of thousands of seeds. Few grow.

In dry, sandy soils in southwestern Kansas, may be found *Riddellia*, a perennial composite about two feet high with numerous brown heads and short three-toothed rays about four to each head. The plant is a very handsome one as it is seen growing.

In the fall of the year, on the sand-hills of the southwest, grows a delicate though somewhat hairy little plant about 18 inches high, with an erect stem, lance-ovate leaves, and brown heads, with 8 or 10 rose-purple rays, broadened at the tip into three long points. This is Neptune's trident

in a sea of grass. Its classical name is *Polypteris Hookeriana*.

In the low sand-hills of the southwest, in August, may be seen a small plant about a foot high, with weak hairy stems and hairy ovate leaves having a very large trumpet-shaped white flower in the axil of each leaf. This is the fragrant heliotrope. It opens its flowers a little before sunset each evening.

6.—SALT-MARSH VEGETATION.

There are numerous salt-marshes in the State that contain a vegetation peculiar to such localities, including a few plants that are known to exist along the Atlantic coast, and have not been found anywhere else in the interior of the country.

Conspicuous among the plants growing in salt-marshes, is the common salt-grass, a sub-species of *Uniola*. A grass growing in dense mats on the ground, about 6 inches high, ordinarily, and with seed stems reaching about 8 inches high. It is very common in the salt-marshes along the Saline river, also about Hutchinson and on the bottoms of the Cimarron and other streams in the salt regions of southern Kansas. Wherever it grows beside a naked patch of earth, as a ditch recently dug, it sends out numerous runners, that reach five or six feet in length and soon cover the ground.

In the saline bottoms near Salina and Abilene, near Hutchinson, near Arkalon, and dozens of other places, grows a perennial form of pigeon-grass, or wild Hungarian grass. It forms a fairly good sod.

Another grass that is very common in the salt-marshes,

is what is known as "fine-top," a grass growing in dense mats on the ground, commonly about 6 inches high, and with much-branched stems, standing erect, about $2\frac{1}{2}$ to 3 feet high, the branches and sub-branches being very numerous and slender.

A common weed in such localities is a species of atriplex, with small, very fleshy leaves, about two-thirds of an inch in length and one-fourth of that in thickness.

Other plants of the same family that are found almost entirely in salt-marshes are glasswort, blite, and saltwort, like the atriplex spoken of. These plants all have fleshy leaves, and seed similar to the pigweed.

A variety of saltwort, that has lately been introduced from the north, is what is known as "Russian thistle." This is a plant that is confined almost entirely to saline lands, and seldom grows to maturity on any other soil; or, if found growing on lands that are slightly saline, disappears from such locations after a few years. It is not to be dreaded in this State, as it does not do well on lands that are not saline.

A plant of the same order is a sort of goosefoot, some species of which are called "pigweeds." The plant grows to be about two feet high, with numerous broad, fleshy leaves, and in dry weather it is always covered with an inflorescence of salt.

None of these plants are eaten by cattle or horses, except that the fine-top grass is sometimes eaten sparingly.

On low, dry, saline prairies may be seen a gentian-like plant, with very smooth glaucous ovate leaves, with entire margins and handsome purple flowers that open their petals wide. The flowers are two to three inches across,

with several in bloom at the same time on each plant, making a most beautiful object. This plant is called *Eustoma*.

Along the margins of alkaline and saline marshes may be found clumps of *flaveria*, a narrow-leaved composite plant, about two and one-half feet high, with very many small triangular heads aggregated into a compact corymb on top. Each head is furnished with a single small yellow rays; the rays are all turned outward from a common center. Each little head has five florets, one of the ray and four of the disk.

7.—PLANTS OF THE PLAINS.

a.—ADAPTATIONS.

It will be seen from the rainfall table on page 16 that plants, to live and be able to propagate on the dry western plains, must be either of two kinds—a short-lived annual or a long-rooted perennial. May and June, being the rainy season, is the most charming time of the year on “the plains,” covered as the earth is with many large and beautiful flowers at all hours of the day and night.

Notable among the long-rooted perennials are the following:

Buffalo-grass, otherwise called curly mesquite, summer mesquite, which, while it stands only three to five inches high, has roots that reach down five to ten feet from the surface; and in digging new wells on the prairie, by careful watching, have been traced to a depth of fifteen feet from the surface; thus reaching down to that stratum of earth seldom affected by summer heat.*

*Transactions Kans. Acad. Sci., VII, 1880, p. 53.

"In a small paddock there had been growing for some years past a perfect sward of buffalo-grass about a foot thick; but cattle and horses would only eat it during the winter, after the frost had affected it. In sinking a well to provide water for horses, the buffalo-grass was traced ten feet down, through the red soil about five feet, and then into a stratum of gravel and sand about five feet, strong straight roots with great masses of feeding root-lets." †

This grass has its male and female flowers on separate plants. On the plains the plant usually propagates by runners; hence we find patches all staminate or all pistillate, as the case may be. The staminate blossoms with their orange anthers are quite noticeable, as they stand four or five inches high; but the pistillate blossoms are hidden under the grass about one to two inches high, and must be sought attentively to be found, and may then be found in abundance. The seeds of this grass are gathered and cached by prairie squirrels and wood-rats. One wood-rat's nest, found in the winter of 1877, contained nearly half a bushel of seeds.

Leather-root, a perennial having upright annual stems $2\frac{1}{2}$ to 3 feet high, with many branches and sub-branches, 3- to 5-leafleted, glandular-dotted leaves, and racemes three inches long, of handsome purple-blue pea-blossom flowers. This has long slender roots reaching down to a depth of 15 to 20 feet, or greater.

Shoestring, a shrubby little plant of the sand-hills and sandy prairies, two to three feet high, with gray or hoary pinnate leaves, having 15 to 25 small oblong leaflets on

†Indian Agriculturist, Sept. 1893.

each leaf, and, terminating each of several of the upper branches, one to five or six spikes, two to four inches long, of very small pea-blossom-like and very fragrant flowers, with only one petal—the banner—which is sky-blue and enwraps the blossom like a cloak. Just below the surface of the ground is a crown, from which arises sometimes five to eight or more stems, forming a cluster of small shrubs, at other times only one stem, which stands erect like a little tree, and when growing on a rocky hillside, where protected from fire, is hardy enough at the base not to be winter-killed quite down to the ground always. Dropping down from the crown are several exceedingly tough roots, no larger than a lead pencil, going straight down toward perpetual moisture. These roots have been traced down, in digging wells, to a depth of 26 feet;* it is probable that that depth is frequently exceeded. Several divisions of the root, before reaching that depth, reduced the thickness to veritable strings; so that at last they were merely fine whitish threads.

Bush morning-glory, or “man-of-the-earth,” a semi-erect vine with long narrow leaves and reddish flowers, with a tube four to six inches long and a corolla three inches across, has a very large fusiform root, four to ten inches in diameter, and three to six feet in depth, that sometimes seems to get larger as the depth increases. The termination of some of those very large roots has never been reached; so the depth cannot be stated.

Wild gourd, also called “man-of-the-earth,” is another very large root, whose depth cannot be stated.

Narrow-leaved yucca, a plant of the rocky hillsides and

*Transactions Kan. Acad. Sci., VII, p. 56.

sandy prairies, has roots several inches thick, and 25 to 50 feet long, or more than that, and ready to throw up a new plant wherever the root comes near the surface. This apparent root is often an underground stem, with a regular subterranean bud at the tip. The extreme length of these roots has never been determined.

The scarlet mallow, a pretty little malvaceous plant, four inches high, with numerous salmon-colored flowers, has roots and underground stems that may be followed in embankments for 20 to 40 feet, from which arise occasionally, though sometimes at distances of 15 to 25 feet, flowering stems, showing where the creeping stems have come near the air and possibly become injured.

Many other plants with extraordinarily long roots might be named; but possibly it is more accurate to regard such roots on prairie plants as ordinary.

Alfalfa, a newly introduced plant on our western prairies, is known to have roots 15 feet in depth at three years of age, thus giving it a foothold on our prairies that red clover cannot hope to attain.

It is characteristic of perennial plants of the plains that they have very long roots, reaching well down into the earth. They are also supplied with numerous buds at or near the crown, so that in case of the destruction of the overground stems by fire or otherwise, the abundant plant food that is stored in the long and large roots enables the plants to make a rapid growth and mature their seeds before the season of annual fires.

Long roots, however, are not confined to plants of the plains. The grape, for instance, it is well known, when old, may have roots 30 to 60 feet in length; though in this

case there is no necessity for the roots to go straight down, as the plant grows where moisture is always plenty.

b.—SEQUENCE OF FLOWERS.

March.

Two little plants of the western prairies that open their blossoms in March are, when fully grown, about three inches high, but when they come into bloom are about one and one-half inches high, or even less. They belong to the parsnip family, and have no common English name. They have small umbels of greenish-yellow flowers, and when ripe one of them has seeds about the size and shape of a parsnip seed, thin and flat, with two wings on opposite edges, though often the seeds are greatly inflated by reason of the presence of a small beetle in each. The other has seeds similar, except that each seed has about four or five vertical wings arranged equidistant around the outer side of the seed. It should be remembered that the seeds of all plants of the parsnip family are in pairs, and face to face. Seeds have various shapes, such as wafer-shaped, saucer-shaped, cup-shaped, terete, cylindrical, prismatic, semi-globular, and globular.

April.

On dry open prairies in April there is an attractive little plant about two or three inches high, with a pretty rosette of oblong or spatulate leaves on the ground, from which several small stems arise, each bearing at its summit a smaller rosette of similar leaves, from which again arise a number of very small pedicels, not exceeding one inch in length, each bearing at its summit a very small white 5-pointed flower.

Very pretty and quite abundant in dry places, though very ill-scented, is the long-flowered puceoon or stoneseed. The flowers are numerous on a plant 10 inches high, are yellow, tubular, and open into five partly crimped or scalloped segments. Though often called honeysuckle, the scent forbids the name. There are four naked white seeds resembling white marsh shells.

On the dry prairies of western Kansas, from a deep perennial root, appears a little hairy composite plant about two inches high, with linear leaves, two inches long, all in a bunch, and in the center a head with purple or white rays, making a flower about two inches across, entirely disproportionate to the size of the plant; and were it not for the little bunch of leaves, the plant would be apparently all flower. The name of the plant is *Townsendia*, and it blooms as early as April and May, making it one of the earliest composites to bloom.

May.

In the sand-hills of the southwest, in May, the white-stemmed evening-primrose comes into bloom. It has handsome white flowers with cordate petals, opening in the morning and turning rose-color. The stem is upright, branched; the leaves are pinnatifid.

On dry hills and well-drained ground may be seen in abundance the silky sophora, one foot high, with its beautiful, whitish-green, silky, pinnate leaves, terminal racemes of yellow pea-blossoms and handsome lead-colored calyxes. The pods, when grown, are constricted between the seeds, making a sort of necklace of each pod.

In wet buffalo-wallows, and other wettish holes, there is a biennial species of evening-primrose growing low to the

earth, with many runcinate-pinnatisect leaves, about like those of the dandelion, and with rhomb-shaped yellow flowers, having a calyx tube three inches in length. When the seed is ripe and the leaves have fallen, the very short stem is entirely covered with the sessile, four-cornered obpyramidal capsules, as close as they can be crowded together. It much resembles, in size, shape, and color, an old overgrown pine cone.

One of the earliest composite plants to unfold its blossoms in the spring is the golden senecio. It grows about wet places, one to two feet high, with many bright yellow heads.

On the dry plains of western Kansas may be seen occasionally in certain spots, numerous plants of *Evolvulus*, a species of dwarf morning-glory, 3 to 6 inches high, with silky ovate leaves, one-half inch long or more, and a very small trumpet-shaped reddish-purple flower in the axil of each leaf. These flowers, like other flowers of the morning-glory family, open very early in the morning and close about noon.

In the rich, alluvial river bottoms all over western Kansas grows the common barnyard-grass, just as though it had lived there always. It seems to be perfectly at home, but grows rank in rich places, reaching a height of six or eight feet, with spikes six or eight inches in length.

Along the river and watercourses there is a species of blue-grass (*Poa compressa*), with flat stems, a much bluer grass than the Kentucky blue-grass. It is quite abundant, and blooms about the middle of May. It is a valuable and desirable grass, makes a nice sod, and is growing more plentiful each year.

Pentstemons are frequent and of several different kinds, mostly to be found on the dry grounds. There is a handsome species of white pentstemon growing abundantly on dry hillsides. It has waxy-looking leaves and spikes of white, rarely pink, flowers, 15 inches high.

About the 20th of May, on dry hillsides, may be seen, in abundance, a tuberous dandelion, with brilliant yellow, dandelion-like flowers, two inches across, which are rendered more showy by contrast with the black anthers. The flower is single, on a solid, striate, one-bracted scape, rising from a radical stem, which in turn rises from a small whitish, spongy tuber, three or four inches deep in the ground. But one stem usually grows from one tuber; but frequently the stem is branched at or below the surface of the earth, and several scapes may arise in succession, each bearing one head. Frequently the stem may be destroyed, or even the top of the tuber cut off, in which case the tuber throws up a new stem from an almost invisible eye. The leaves, which may be called radical, are mostly at the top of the subterranean stem, and are fewer, shorter, and not so deeply gashed as dandelion leaves. The juice is milky, like lettuce. The stem has two or three scales with dormant buds between the leaves and the tuber; the tuber has several almost invisible eyes.

A charming little bloomer in dry situations is white polygala, ten inches high, in dense tufts of slender stems, covered with spikes of small, white, oddly-shaped flowers, that last till the seed is half ripe.

Toward the last of May, a very small species of aster-looking flower with white rays grows abundantly on dry rocks, and is interesting from that fact. It is a perennial

herb five inches high, much branched, with minute, hard, very green heath-like leaves and white heads one-half inch across. It is quite rare except where it grows, and there it is plentiful enough.

In the dry rocky and sandy bluffs of western Kansas may be seen small clumps of moss-like plants one or two inches high, with very small closely packed leaves, as on mosses, and covered with small white tubular flowers. This is the moss phlox. On attempting to pull up a plant it is found that considerable of a clump of flowers are fastened together by branches united underground into a trunk; and it appears as if a plant had started growing many years ago, and being almost covered up with sand had year after year been able to keep its head aboveground, until, when dug up it covered a space about fourteen inches across, with about fifty branches underneath, united below into fewer and fewer, finally into one stem about three inches long, which separated at its base into several small roots. The whole plant, when divested of its sand, was about eleven inches high, with a dome-shaped or flattish green top, compact, and greater in breadth than in height.

Toward the close of May the straw-colored pincushion cactus opens its blossoms. The petals vary from a straw-color to amber. The stigmas are green. In a day or two the red pincushion cactus may be found in bloom. The petals vary from a pale pink to a bright red. The stigmas are red, pink, or pure white—never green. The plant, when not in bloom, is easily distinguished from the straw-colored cactus by its having several divergent brown spines on the ends of the tubercles, in addition to the circle of

white spines. The flowers rise from the body of the plant in the axils of the tubercles. The fruit, too, is green when ripe, while that of the straw-colored species is red. Otherwise they are much alike.

June.

Squirrel-tail grass grows here and there along the sloughs, and must be seen to be appreciated. Seedsmen advertise it freely as an ornamental grass.

Sandworts are common in the dry rocky and sandy hills of the west, and are very interesting with their whorls of green awl-shaped leaves at the joints, and their numerous small white flowers. They are usually tufted.

Nearly everywhere on dry prairie and very abundantly on barren prairies, in central and western Kansas, grows the smoke-weed, a species of plantain, with hoary gray spikes eight inches high of minute white flowers. Growing alone on barren hillsides, it gives the land a bluish-white or smoky appearance; and in western Kansas, where it grows abundantly in places, it is said to have been the cause of the name of the Smoky Hill river.

In dry soils on low grounds in southwest Kansas, may be found a very rough branching composite, with pinnatifid leaves and numerous brown heads, with about eight yellow rays resembling coreopsis, except that the plant leans instead of growing erect, and is very rough. This is Engelmannia, and is quite common in spots where it is to be found.

About the middle of June, the wild gourd comes into bloom. The root is a large inverted cone, sometimes 12 to 16 inches across, perennial, and throwing out numerous trailing vines each year from the margin of the crown.

The leaves are large, rough, cordately triangular, rising from the vine right and left, and pointing outward. The fruit is globose, one at each leaf nearly, about the size of an orange, and striped yellow and green.

On dry prairies is found the prairie cone-flower, a plant two and one-half feet high, with numerous brown or purple conical or columnar spikes, one and one-half inches long, and large yellow drooping rays. Sometimes the base of the rays is brown and sometimes the rays are entirely brown.

There is another species of cone-flower, one and one-half feet high, with short yellow rays and finely divided foliage, found growing in clumps on lower prairies and also on dry rocky hills.

Generally in sandy places grows the beautiful thistle poppy, with large, white flowers four inches across, with numerous yellow stamens. The leaves are green, with white veins, plenty of thorns, and the flower-buds and seed-pods are burry.

Anywhere on the low prairies may be found a half-shrubby plant of the pea family, two or three feet high, with handsome racemes of whitish flowers followed by burry or prickly pods. The common name for this plant is bur-pea. The root is somewhat sweetish, with a slightly licorice-like taste. The plant is related to the licorice plant.

On sandy prairies and on grassy hill-sides grows a species of 5-leafleted psoralea, called Indian bread-root. The bulb from which the plant grows is about the shape and size of a small turnip, and is six or eight inches deep in the ground. The bulb, when not more than two years old, is soft and edible; but, after that, becomes hard and

woody; and when 6 or 8 years old, has attained a diameter of about two inches, and is composed of annual rings of wood like a tree. The wood is hard and close-grained as box-wood, and about as difficult to saw through; still the vertical diameter of such a bulb is not more than about three inches.

About the middle of June, the buffalo-bur, a very prickly weed, too well known in Kansas, commences to open its yellow blossoms. When dead and dry it is one of the worst weeds to encounter, as the poisonous thorns break off in the flesh and inflict much pain. By a sort of reverse action it is a sign of a farmer's thrift; as it always grows abundantly in neglected fields. Kansas disowns the pest, and claims it is a gift from Colorado, or New Mexico, or Sonora, or anywhere else outside of Kansas. The plant was the favorite food of the Colorado striped potato beetle until the arrival of the white man with his Andean potato, which proved so much more to the beetle's taste that he has abandoned the buffalo-bur (*Solanum rostratum*) and made his home permanently on the potato (*Solanum tuberosum*). He has even migrated to the East and invaded the potato-fields there; and, being no doubt misled by market reports and common accounts current, in his ambition to find the original potato-field, he has crossed the Atlantic ocean and attacked the fields of Ireland, England, Germany, and Spain. Let us hope that he may not also reach the mountains of Chili and Peru.

Frequent on the prairies in the extreme western part of the State, in June, may be found some small cacti with vertical ribs and knots of thorns at regular distances. It

is the green-flowered hedgehog cactus. They are usually two or three inches in height, and resemble very closely the pincushion cactus. The flower is green with a slight tinge of straw color, and opens between two and three o'clock in the afternoon and closes before sunset. They probably open several days in succession, though that has not been verified.

On the dry prairies, in southwestern Kansas, may be found the prairie zinnia, a perennial, half-shrubby, tufted plant, rough and much branched, with many heads terminating the branches. The heads have 4 or 5 broad yellow rays, making flowers an inch and a half across.

July.

At Hutchinson, on the Arkansas, in the sand-hills near by, also on the Ninnescah, Chikaskia, and the Cimarron, appears a bushy shrub, like a clump of willows, and having narrow leaves much like the willow. But the flowers are different from those of any other tree in the eastern United States. It is the willow baccharis, a plant of the sunflower family. The staminate and pistillate blossoms are on separate trees. The seeds are in heads, and have a pappus. It is the only shrub of the sunflower family in the State.

In low swampy spots in western Kansas may be seen clumps or patches of wild senna, a plant 7 feet high, with few branches at top. The flowers, which are like those of the cassia, are succeeded by pods, three or four inches long, with numerous seeds and walls between the seeds. When the plants have ripened, in the fall, the numerous pendulous brown pods give the plant a singular appearance.

On the prairies of the northwest, in July, occurs abun-

dantly in spots the cut-leaved evening-primrose, an erect plant a foot or so in height, plants numerous growing from a very long, horizontal, perennial underground root-stalks. The flowers are single in the axils, white, turning pink as they decay. The capsules are four-cornered. The leaves are pinnatifid.

In sandy spots on the prairies of northern and western Kansas one may find a biennial evening-primrose, with straight erect stems, 3 feet high, lanceolate leaves, and terminal spikes of yellow flowers, with rhombic petals and calyx tubes one or two inches in length. The flowers open about sunset.

On low grounds, in "draws," in northwestern Kansas, appears a beautiful pink evening-primrose, on short vines or stems that lean on the ground, several from the same perennial root. The flowers are $2\frac{1}{2}$ inches across; are a bright rose-color and have heart-shaped petals.

On the bluffs of central and southern Kansas is Frémont's evening-primrose with tufted stems, 6 inches long, from a perennial root, narrow silky leaves, and flowers 2 inches across, with a calyx tube two to three inches long, and a seed capsule with four broad wings. This is similar to the Missouri evening-primrose, spoken of in the chapter on prairie flowers, and it grows in similar situations; but it is less silky than that; the leaves are much narrower; the flowers much shorter and not so broad; and the wings of the capsules much less; but both open at the same time of day. Specimens may frequently be found intermediate between the two; and sometimes it will be difficult to tell which species the specimen most nearly resembles.

On low grounds on the western prairies grows the great-

flowered grindelia, a leafy plant 4 to 7 feet high, with a few branches on top, each terminated by a yellow composite flower, two inches across, with about 20 slender rays. The leaves are elliptic in outline, with spiny teeth like the leaves of holly, except more slender and more numerous. The plant is not dotted or gummy.

On the low prairie near Garden City, and on alkaline prairies in many places in western Kansas, grows a plant that spreads on the ground like prostrate spurge; but, unlike spurge, it has larger, hoary-green, rhomboidal leaves, varying from one-third to one inch in length, and nearly equal in breadth. The branches and leaves are so numerous as almost to cover the ground. The leaves are covered with a dense woolly tomentum, with branching or stellate hairs. The flowers are not noticeable. The plant is named *Cladothrix*.

On barren tracts in southwestern Kansas may be found great fields of spider-flower, a species of cleome with handsome, ill-scented foliage, and racemes of pretty pinkish flowers, having each six long stamens (legs) hanging down from the flower, like the legs of a mudwasp when he flies. The flowers yield honey; though, where they grow, bees must be very scarce.

In gravelly hills, or old quarries on southern hillsides, grows the clammy weed, a viscid, coarse weed, about a foot high, with three leaflets to each leaf, a terminal raceme of ill-scented flowers, and upright pods somewhat inflated. It belongs to the same order as the last, and is a bitter, clammy, disagreeable plant. It endures very hot weather.

On dry prairies in the buffalo-grass region may be seen a plant called nailwort. It is like a little tree, six inches

high and eight or ten inches across, much branched and forming a rounded dome of green on top that is very conspicuous on the prairie. The leaves are opposite and awl-shaped, and at the base of each leaf two stipules, that are very thin and transparent, also awl-shaped and nearly as long as the leaves proper. This makes apparently six leaves in a whorl at each node or joint, four shorter than the other two. The flowers are on top, very numerous, small, green, 5-pointed, and inconspicuous.

In rocky and sandy bluffs is found another species of nailwort, very like the one mentioned; but with the trunk and branches often covered up with sand, giving the top a mossy appearance.

On the sandy and dry plains of southwestern Kansas may be found vast quantities of "sage-bush," a species of shrubby artemisia two to three feet high, growing in small clumps at distances of 10 or 20 feet or more, often much more. This is an aromatic composite plant, with numerous very small heads, and with simple hoary leaves having three rounded teeth at the tip.

Many other species of artemisia or "wild sage" are found all over the State, most of them with very narrow or finely divided hoary, woolly, or silvery leaves. They are well adapted to the climate.

CHAPTER III.

PLANT HABITS.

1.—ANNUAL PHENOMENA.

The character of the plants in bloom varies perceptibly from week to week. For instance, all fruit and forest trees have passed blooming with the month of May; crucifers and crowfoots have been quite numerous early in the season; leguminous plants are more frequently seen in June; the showy figworts and kindred plants are becoming frequent then; these will be succeeded by the mints in the middle of summer; to be followed in turn by the universal compositæ, which hold their reign majestically until snow comes in winter; as the sow-thistle continues to bloom until November.

That plants have a regular time each year for leafing, blooming, and fruiting, is a fact well known. From the first blooming of the hazel, early in March or even in February, to the final blooming of the sow-thistle, in November, there is a constant succession of bloom, and each and every plant passes through the successive steps of its development in its appropriate season. There may be a difference in early spring of as much as thirty days in the first blooming of certain plants, according to the advancement of the season. As the summer progresses the differences of time of first blooming in different years decrease, until in midsummer it is rare to find a difference so great as ten days in the different years; and later in the

fall it must be an unusual year indeed that makes even so much of a difference as ten days to occur in the first blooming of a plant at any one place. Hence, in general terms, a late spring, an early fall, and a short growing season, hastens the growth and development of a plant; and a long season retards the maturity and increases the growth of the plant.

Generally, plants are so prompt about their motions, such as the opening of leaves and flowers, that an average day may be taken for the first blooming of any individual species; and that particular species will be ordinarily found in bloom within three days from the appointed time, but oftener on the particular day. This refers especially to particular plants in a certain location.

Each species has its set time for performing its different functions; each different variety has its own time, often differing widely, as in the ripening of apples. Further than that, each individual tree has its own certain time for opening its leaves, blooming, and ripening its fruit, from which it seldom or never varies a day in years having equal temperature during the days and months preceding the looked-for phenomena. For instance, a certain large male cottonwood tree comes into bloom usually about April 8th, and in four days it has shed all its blossoms. Four days later, April 12th, a large male cottonwood tree opens its blossoms. On the 13th it is fairly magnificent in its wealth of bloom, and two days later it has shed every blossom. Five days later a large male cottonwood expands its flowers and for two days is a most beautiful object, and then promptly sheds its limp aments with their depleted anthers. Between the extremes mentioned, or say between

April 6th and April 20th, every cottonwood tree, male and female, has fulfilled its estival mission and started in untold numbers the germs of future cottonwood trees.

2.—DIURNAL PHENOMENA.

Not only do plants have a season for blooming, but many plants also have a particular hour of the day for unfolding their petals and a particular hour for shutting up shop and retiring.

The morning-glories, for instance, are like milkmen; they are at their best early in the morning and retire about noon. The common morning-glory opens before 5 o'clock, and the blue morning-glory opens after 5, or about an hour later.

Similarly, our wild bush morning-glory of the prairies, the immense roots of which many of our western Kansas farmers have encountered with the plow, opens at 4 o'clock in the morning, very regularly.

Two other species of morning-glory, both with small white flowers, open still earlier. One of these, the field bindweed, has small arrow-shaped leaves and creeps on the ground; the other, the scarlet cypress-vine, has medium-sized, heart-shaped leaves, with a small lobe on each side, and climbs. Both of these have tuberous roots, and hence are, in a sense, perennial.

The common white morning-glory, or bindweed of our hedges and thickets, opens very early in the morning, perhaps soon after midnight; and yet another, the common white creeper, opens several hours before midnight, or late in the evening; hence is called the evening beauty. Several other species of *Ipomœa*, commonly called moon-flowers, open at early evening and close at daylight.

One remarkable thing about this family of morning-glories remains to be told: all the night-blooming species are pure white, and all the morning-blooming kinds are colored. True, there are white varieties of many of the day-blooming kinds, as a white variety of the purple morning-glory, a white variety of the blue morning-glory, a white variety of the red-flowered cypress-vine, etc.; but in all of these there are traces in the center, or along the ribs of the corolla, of the original color, and none of them is pure white.

The crimson poppy-mallow, one of the brightest and most frequent flowers of the low prairies, is a regular farmer, opening early in the morning, usually before 7, and closing from 6 to 7 in the evening, thus putting in a good honest twelve hours each day. It reopens next morning for several days in succession, thus making most of its resources.

But, though the flowers reopen and are ready for work several days in succession, the pistils and stamens of the same flower do not work together. Flowers differ in this regard. Sometimes it is the stamens that are active first, though generally the reverse is true.

Suppose their anthers are ripe the first day: to the visiting insects, invited by the odor of the delicious nectar at the base of the flower, the stamens freely give up their load of pollen, and often without asking the insect's permission. Next day, when the flower reopens, the stamens, having been active on the previous day, have gone to sleep and the pistils are wide awake and ready to receive pollen through their stigmas. There is still some nectar left. Insects are invited again; and they come bringing in their

hands (on their feet) and on their backs some gifts of pollen from a neighboring flower. It is the price they pay for the nectar they receive. The stigmas are ready to receive it and catch the pollen with avidity, without harming the insect in the least; and no doubt the insect is glad to have part of its burden removed. Both insect and flower are benefited by the change.

This work completed, the flower opens no more. The nectar is gone; the petals lose their brilliance and drop off; the stamens wilt and fall; but the pistil grows and grows, and ripens seed.

The dandelion, a very different flower from the crimson mallow, keeps the same hours. The dandelion, though, like the farmer's hired man, has an additional trick—he closes up if it is going to rain more than the merest shower, and doesn't go to work again till the sky has cleared. How beautifully the dandelion, when his seeds are ripe, folds back his involucre (his cloak), and every individual seed raises high his parachute above his head and goes sailing away on the breeze when his turn comes.

Violet sorrel opens early in the morning and closes about noon. The spiderwort and dayflower do the same. They belong to the Early Closing Association.

Specularia, the old maid's mirror, is a pretty, purple, star-shaped flower, frequent everywhere on the prairies; but, to be seen at all, she must be seen when she is ready for callers, namely, from 9 A. M. to 2 P. M. She doesn't reappear next day in the same dress, but has a new one each day.

The regularity of opening of many members of the chickweed and purslane families is well known, the former flowers opening in the evening, the latter in the morning.

The portulacas and yellow flaxes and bluets are bankers, not merely because they grow on a bank. They open for business at 9 o'clock in the morning and close at 2 in the afternoon. Then, too, look at the silver in their leaves and the gold in their coffers (anthers). These are the wealth of the flowers. And if you turn their leaves over you will see plenty of green backs.

The cactuses, nearly all of which bloom in June, will be found to be periodical and regular in their habits. They open at various hours; but any one kind always opens and closes at the same hours.

Another group of flowers noted for their great regularity is our wild four-o'clocks, called allionia. The common kind, with the large, heart-shaped leaves, opens its flowers very regularly every afternoon at 4 o'clock, even much more regularly than the four-o'clock of the gardens. Another, with a deeply-lobed white calyx, opens at 5 o'clock, or from that to 6. All the species of allionia open late in the afternoon.

How many have noticed our common jimson opening from 5 to 6 o'clock every evening? Just as regularly, it closes early in the morning. Several of our cultivated jimsions, with their magnificent white flowers and delightful fragrance, open very promptly at sunset, and close just as regularly in the early morning.

Another plant of an order somewhat allied to the morning-glories, and with a strong tendency to periodicity, is the fragrant heliotrope, which is common on the sandy plains of southwestern Kansas, and spreads its sweet-scented white trumpet flowers in early twilight.

Several plants of an order allied to the evening-prim-

roses, and somewhat to the poppies, are periodic in the time of opening their flowers. The small orange-flowered mentzelia opens early in the morning and closes about 1 o'clock in the afternoon.

The tall mentzelia with remarkably large, creamy-white flowers, opens at three o'clock in the afternoon, with its buds all turned toward the southwestern sky, so that the flowers open directly in the face of the sun, just as the daily temperature has begun to decline.

The great-flowered mentzelia, with still larger, yellowish-white flowers, opens an hour or two later. Both of these close early next morning, and remain asleep all day to reopen in the afternoon.

The evening-primroses, too, have as great variation in their times of blooming. Like the printers on the morning papers, they open very promptly about 7 o'clock in the evening and continue to exhibit their splendors to the star-clad world until the rosy morn.

The common great-flowered evening-primrose opens very promptly at 7 o'clock in the evening, and wilts about 7 o'clock next morning.

A still larger and more remarkable flower, the Missouri evening-primrose, found on the rocky hills of eastern Kansas, opens more promptly at 7 o'clock, or just about sunset.

A small-flowered species, the cone-stem evening-primrose, opens earlier, or about 6 o'clock, and remains in bloom all next day.

One species, the white evening-primrose, blooms in the morning and continues in full bloom all day, finally turning slightly pink.

The gauras, belonging to the same family, are just as

regular in their habits. The scarlet gaura opens at 6 o'clock in the evening; is a pure white all night; and changes to a beautiful rose-color at daylight, which color deepens slightly until early afternoon, when the flower wilts.

Biennial gaura, a tall weed with long, slender, far-reaching branches, opens its pure white flowers an hour after dark, from 8 to 9 in the evening, and remains open until about 10 o'clock next day, still very white, but changing slightly to rose-color before fading.

The small-flowered gaura, known by its silky leaves, opens at the same hour, closes a little earlier, and changes strongly to rose-color before fading.

These features are here tabulated into a sort of floral clock for the State of Kansas.

3.—FLORAL CLOCK FOR KANSAS.

This "clock" represents the time of day of the opening and closing of a large number of native flowers of Kansas, and is the result of many years' observations on Kansas plants. The time given for each species is that observed during the height of the flowering season for that particular species. The time of opening (and closing) is modified somewhat by the length of the day and dense cloudiness. The clock is still subject to correction, the result of further needed and closer observation:

1 A. M. Thistle poppy; flowers remain open all day.

Hoary bindweed; flowers close about noon.

2 A. M. Hedge bindweed; flowers close at evening.

Wild moonflower; close at 10 A. M.

3 A. M. Bush morning-glory; flowers close at noon.

Wild potato vine; close about 2 P. M.

- 4 A. M. Scarlet cypress-vine; close about noon, except in cloudy weather.
White evening-primrose; last all day.
Dwarf dandelion; close at 10 A. M.
- 5 A. M. Purple morning-glory; flowers close about 11 A. M., except in cloudy weather.
Blue morning-glory; close about noon, except in cloudy weather.
Small mentzelia; close at 1 P. M.
Day-flower; close in heat of day.
Dwarf morning-glory; close at 3 P. M.
Yellow water-lily; close at 6 P. M.; reopen several days in succession.
- 6 A. M. Prickly lettuce; flowers close before noon.
Tooth-leaved gas-plant; close early in afternoon.
Spiderwort; close about noon.
Small-leaved gas-plant; close early in the afternoon.
Sow-thistle; wither at noon.
Spring beauty; close in afternoon; reopen once.
Crimson poppy-mallow; close 6 to 7 P. M.; reopen next day once or twice.
White water-lily; close at 3 P. M.; reopen several days in succession.
Field bindweed; flowers close at noon in sunshine, later in cloudy weather.
- 7 A. M. Tuberous dandelion; flowers close at 6 P. M.; reopen for several days in succession; close also in continued rain or dense cloudiness.
Wild lettuce; close about 11 A. M.
Wild geranium; close at noon.

Blue-flowered wild lettuce; close after noon.

Ruellia; flowers drop off about 3 P. M.

Water-willow; drop off middle of afternoon.

Hairy hawkweed; close middle of afternoon.

Notched purslane; close after noon.

8 A. M. Pink poppy-mallow; flowers close in the evening to reopen next day.

Wild dandelion; close at dusk; reopen next day.

Dandelion; close at dark to reopen next day, except in rainy weather, when it may be closed in daytime and open at night. Do not close for a shower in sunshiny weather.

Flower-of-an-hour; close before noon.

Oxalis; close at noon for good.

Pink oxalis; close at noon to reopen once.

Bluets; close at noon; reopen for two or three days in succession.

9 A. M. Yellow flax; petals fall off at 1 P. M.

Large-flowered yellow flax; petals fall off at 2 P. M.

Little bluets; flowers close at 2 P. M.; reopen next day once.

Venus mirror; close permanently at 2 P. M.

Purslane; wilt after noon.

Wild portulaca; close at 1 P. M.; do not reopen; while the flowers of the great-flowered portulaca, a cultivated plant said to be a variety of this, and whose flowers open and close about the same time, do reopen.

10 A. M. Wild cucumber; flowers close at 3 P. M.

Velvet leaf; close before noon.

Prickly sida; close at 2 P. M.

Many-spined prickly-pear; close at 4 P. M. to reopen for several days. This has sensitive stamens.

11 A. M. Large-flowered talinum; flowers close early in afternoon.

Wild gourd; close at 3 P. M.

Little prickly-pear; close at 4 P. M. to reopen for several days.

12 M. Western prickly-pear; flowers close at 5 P. M. to reopen.

1 P. M. Evening hibiscus; flowers remain open until dark.

Terete-leaved talinum; close 2 to 3 P. M.

Catchfly; close at 3 to 4 P. M.

2 P. M. Straw-colored pincushion cactus; flowers close at 5 P. M. to reopen next day.

Red pincushion cactus; close at 5 P. M. to reopen next day.

3 P. M. Tall mentzelia; close at daylight to reopen.
Starry campion; close toward midnight.

4 P. M. Crimson wild four-o'clock; flowers close next morning at sunrise.

White allionia; flowers close next morning.

5 P. M. Great mentzelia; close in the morning to reopen in the evening.

Evening catch-fly; wilt next morning.

Cone-stem evening-primrose; last nearly all next day.

6 P. M. Fragrant abronia; wilt early in the morning.

Jimson; wilt next morning.

Evening beauty; close next morning.

Scarlet gaura; flowers turn pink next morning and fade about 11 A. M.

Stemless evening-primrose; last all next day.

Tall evening-primrose; wilt next day.

Sweet-scented heliotrope; wilt next day.

Point-petaled evening-primrose; wilt next day about 9 to 10 A. M.

Small-flowered evening-primrose; wilt next day.

7 P. M. Missouri evening-primrose; flowers wilt at sunrise.

Great-flowered evening-primrose; open very promptly; wilt at 7 A. M. next day.

Pink evening-primrose; wilt next morning.

Frémont's evening-primrose; open promptly; wilt at 9 A. M. next day.

8 P. M. Biennial gaura; flowers wilt promptly at 10 A. M. next day.

Small-flowered gaura; wilt about 11 A. M. next day.

9 P. M. Tall gaura; flowers last and remain white all next day.

NOTES ON THE CLOCK.

There are many other plants that open at periodic times; but observations upon them have not been sufficient to determine positively their habits. The above clock contains only native and naturalized plants. If cultivated plants were placed in it the 24 hours would be completely filled. Moonflowers and night-blooming cacti fill the rest.

In cases where a flower reopens for several successive days, it will be seen that the stigmas and stamens are ready for action on different days.

It has been mentioned that night-blooming plants are always white or yellow; and that all blue, purple, and red flowers are day-blooming,—not that all yellow or white flowers are night-blooming, or that all day-blooming flowers are blue, purple, or red.

Why are night-blooming flowers white or yellow? Isn't the reason for this very clear? They can be distinctly seen for long distances by night-flying insects.

4.—INSECT FRIENDS.

It may seem that many plants have preferences among the insects. For instance: The Missouri evening-primrose admits the cecropia moth only; no other moth has a sucker long enough to reach the nectar, which is at a depth of nearly six inches; and no other moth is so well adapted to perform the important office of fertilization. The great-flowered evening-primrose admits both cecropia and polyphemus moths; other species of evening-primroses are not so particular.

Again, the red clover, with its large stores of honey, does not admit the common honey-bee; so that that insect must confine its labors to white clover or other flowers adapted to the bee's structure. The red clover prefers the bumble-bee; and the form of that insect is found to be best adapted to fertilization of that plant. So farmers raising clover seed would do well to spare the bumble-bees. The bumble-bee is the farmer's friend.

Thus it may be seen that every kind of flower has one or more particular kinds of insects best adapted to it, and opens at the time of day only when such insects are on the wing.

5.—SENSITIVENESS IN FLOWERS.

One curious feature in this connection may be mentioned: The common prickly-pear conceals no nectar; its stamens are not merely sensitive—they are irritable to a high degree; and when an insect, attracted by the sight and odor, alights upon the flower, the stamens immediately spring in upon him from all around and cover him with pollen. Taken by surprise, he immediately flies away, perhaps to another flower of the same kind, to be treated in the same manner; but, in all probability, the prominent style of the prickly pear is ready to receive the pollen, and quickly catches some of that which the insect has brought with him from a neighboring flower.

6.—SENSITIVENESS IN PLANTS.

a.—TO TOUCH.

Are leaves, tendrils, flowers, branches, roots, seeds, etc., sensitive to light, to varying conditions of the atmosphere, to touch, to contiguity of objects, to gravity?

We have seen, first, how some plants prefer the water, some the wet earth, others dry earth, and still others the most exposed situations; how some prefer shade, and others enjoy the bright sunshine; how each kind of plant has its preferences, in lack of which it fails to thrive.

We have seen also, in studying the diurnal habits of plants, how each kind of flower knows when morning, evening, and midday come; when it is dark and when it is daylight; how the flower knows when its friend among the insects comes.

Plants move; but not quickly. Few plants move quickly; and as we do not see them move, we are apt to underrate their sensitiveness.

The sensitive brier is one that appeals to us, as we can in that see instant motion. The plant does not move for ordinary occurrences. The wind may blow and shake; neighboring grasses and plants may touch and even press; the leaves remain open and unmoved; but let a live creature touch it, and see how quickly the leaflets fold together. Touch it again harder, and see the entire leaf fold down toward the branch. Frequent meddling of this kind causes the plant to die.

Plants are sensitive to touch.

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b.—TO GRAVITY.

A seedling plant starts to grow. Does it know how to grow? Watch it. The roots shoot downward and the stem grows upward. That is, they do that so far as circumstances will admit. If a plant starts in a perpendicular bank the roots run into the bank and downward; the stem outward and upward.

Were it not for the constant influence of gravity on a plant it would grow in whatever direction it first started, which might be at right angles to a perpendicular bank, or might even be downward. But stems always grow upward as near as possible, and roots downward.

Plants are sensitive to gravity.

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c.—TO CONTIGUITY OF OBJECTS.

If the plant be a twining vine, as soon as it has attained sufficient length, the terminal bud begins to move around in a circle, the hop around to the right, looking outward from the center, the morning-glory to the left. As the vine grows it increases gradually the circle in which it moves,

until finally it touches something or drops to the ground from exhaustion or of its own weight. As soon as it has touched something, it makes a short turn and wraps around it, though it may be only another similar vine unable to support it.

These motions result always in each plant growing in the place that is best adapted to its growth. Why, for instance, does the ampelopsis climb a tree, and the Virginia creeper a stone or brick wall, in preference to a bush or a haystack?

The tendrils of the vine at first, like the tendrils of a grape-vine, seek the dark side of the vine, and finding a solid vertical support that they cannot grasp, accommodate themselves to the conditions and flatten the tips, forming sucking disks that take firm hold of the tree or the face of the brick or stone. Here the vine thrives best; and all that portion of the vine leading to the tree, which may be fifty feet from where the seed germinated, dies, giving the vine the appearance of having germinated at the base of the tree or wall.

The same is true of the climbing ivy, which, in order to hold to a tree, sends out numerous rootlets from any place along the dark side of the vine; and the ampelopsis has its sucker-like tendrils at the joints; but how do the wistaria and the clematis manage to climb? In these cases, branches act as tendrils, partly. They bend around projections, and, stiffening with age, hold the vine. Temporarily, leaves do the same thing until the branches have grown.

Why does the pumpkin or gourd climb an old straw-stack and not a tree? They have tendrils, too.

Trees and stone walls and bluffs are permanent features. The ampelopsis and ivy are perennial vines. They are adapted to each other.

Hay- and straw-stacks are temporary features. Pumpkin and gourd vines are annual vines. They are adapted to each other.

We know that if a pumpkin vine should climb a tree the weight of the fruit would destroy the vine. We do not need to suppose that the pumpkin can reason. Let it be sufficient to say that an old strawstack or brushpile and a gourd vine are adapted to each other.

A large cottonwood tree has a limb a foot in diameter about ten feet from the ground. The limb is forty feet long and rises from the horizontal about 30 degrees. The limb has many branches and leaves, nearly horizontal.

The tree has many other limbs and branches above the one mentioned. Standing in a window near by and looking toward the tree, one may see sky all along between the limb mentioned and those above. There is no pressure anywhere. The constant strain of the weight of the limb on itself must be great. Yet fifteen years' acquaintance with that tree and limb shows no sign of change in the direction of growth. It only grows longer and larger.

Suppose all of the tree above that limb were removed without disturbing it. Would the limb continue to grow in the same direction as before? Would not every branch and bud on the limb immediately commence to grow straight up?

Was that limb forced to grow in the direction spoken of by pressure against the limbs above it? Not at all.

How did the limb and every branch and twig and leaf on it know that there were other objects above it and that

if it reached the sky at all it must take the angle it did? Probably the action of light has caused each leaf and branch to so arrange itself as to get the proper amount for its best development.

Plants are sensitive to contiguity of surrounding objects.

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d.—TO ATMOSPHERIC INFLUENCES.

The dandelion opens regularly every sunshiny morning at 8 o'clock and closes at 6 in the evening. On densely cloudy and rainy days it does not open until the rain clears off. Or, if a rain and much cloudiness come up while the flowers are open, they close. If it be rainy all day, the flowers remain closed all day. If a second rainy day follow, a few flowers open toward noon or in the afternoon. If this be followed by a third rainy day, many flowers open; but they are a forlorn and sorry-looking lot.

The seeds of the weather-grass (*Stipa*) have each, at its upper end, an awn about four to six inches long. Each seed has also at its lower end or point, a circle of small hairs or barbs reaching back toward the awn. The awn when ripe twists and bends at right angles in the middle, like an auger with one handle. In damp weather or at night, it untwists and partly straightens. This forces the seed forward. When the awn dries again, it twists and draws up. As the seed cannot retreat on account of the barbs, the tail of the awn follows. And as the tail in twisting cannot, on account of obstructions, revolve like the handle of an auger, the seed must twist again, forcing it forward; so the seed moves forward into the ground, whether the awn twists or untwists.

Plants are sensitive to atmospheric influences.

e.—TO TIME.

Leaves, like flowers, often have certain times of the day for opening and closing. Most noticeable among these are certain species of spurge and dogbane. These plants have opposite leaves, and in the case of the spurges, oblique, or lefts and rights; and, as soon as the dew begins to fall, they fold together in pairs, as a child folds its hands in prayer, and with the light-colored under-side out, remain thus all night.

Many of the pea family, notably cassia, sensitive peas, and beggar's lice, fold their leaflets at night. These leaflets are jointed to the midrib, and the midrib to the branch, by noticeable articulations that allow a motion of both leaflet and leaf. Daylight opens the leaflets and raises the leaf. Thus, leaves are said to be asleep when they are closed for the night.

But not all plants fold their leaves with the faces together, as do the plants of the pea family. The sorrel, for example, folds its leaflets back to back, and the whole leaf drops from its junction with the petiole. Again, velvet-leaf, with its very large, velvety leaves, droops straight down from the junction of the blade with the petiole; the petiole remaining in its normal position, and the leaf hanging face outward.

Plants are sensitive to time.

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f.—TO LIGHT AND HEAT.

Everyone, probably, has seen the sunflower turn its leaves eastward to the morning sun, and westward in the evening. Many other plants do precisely the same thing, among which may be noted beans, ragweed, rosinweed, marigold, and many other plants of various families.

One notable plant of this character is a certain variety of turkey-bean whose leaves turn eastward in the morning and westward in the afternoon. To facilitate this, all the branches and branchlets grow toward the north and south, so that the leaves simply have to rise on the one side and lower on the other.

In the case of the compass-plant, where the two surfaces of the leaf are just about alike, the leaves do not turn one face upward, but stand vertical, with one face to the east and the other to the west, and with the edges north and south. Thus, the leaves, which are rigid, get the benefit of the morning and evening light and avoid the intense light of noonday. This plant only grows on the open prairie, in a sunshiny country.

But do plants actually see?

How often have we seen potato-sprouts, turnip-tops, and other plants in the cellar, stretching out as far as possible and leaning over in an attempt to reach the window where the only feeble rays of light enter the cellar. In the same way we have all seen, in the open air, the leaves turn their faces up to the light; and when they grow on the side of a house, turn sidewise to the light; and if under a roof, will still turn their faces toward the brightest light. And the tendrils, those modified forms of leaves, always turn away from the light.

We are not aware that we are cognizant of light by any organ except our eyes, and we call that seeing. The plant is cognizant of light in its leaves, in all their modifications. Is it not, at least, analogous to seeing?

Plants are sensitive to light and heat.

CHAPTER IV.

POLLINATION AND REPRODUCTION.

Life in plants, as in animals, consists of two sexes, male and female. A union of the two sexes in the higher plants is essential to the production of a new life.

1.—METHODS OF REPRODUCTION.

Perpetuation of species may result from either of two methods:

1st. Division by separation of leaf-buds, which are sexless, as in grafting an apple, budding a peach, or layering a grape. Separation of tubers, bulbs, corms, runners, etc., is equivalent to separation of buds, and reproduces the same kind of plant, with such slight modification as may be owing to climate, soil, or other environing condition or influence.

2d. Reproduction by union of reproductive parts, which are sexual.

Individual lives in plants may be differently considered. A tree, for instance, may be deemed an aggregate or compound being, and each bud may be considered an individual.

Each flower may be regarded as a community in which the members are all male, all female, or both male and female. Where the members of the flower are all male, the flower is called staminate or sterile; where the members are all female, the flower is called pistillate or fer-

tile; and where flowers comprise both male and female members, the flower is called perfect. The male members are always placed in the outer set or sets of apartments; the female members are always placed in the center, the sanctum, the best-protected place, the culmination of growth.

a.—MALE FLOWERS.

The stamen, the male organ, consists of two parts: the filament and the anther. The anther contains the pollen.

The filament is merely the stem of the stamen. It is usually small, like a thread; it may be long or short, or entirely absent as in the silkweed (or milkweed).

The anther is a double glandular organ on top of the filament. It is fixed to the filament in a great variety of ways, commonly, nicely balanced by its center on the tip of the filament, as in the lily; at other times firmly fixed to the filament like the blade of a spade to its handle, as in the pumpkin. The anther usually has two cells, which commonly, but not always, open by a slit on the side of each cell, farthest from the pistil; though sometimes by a minute pore at the end, as in the huckleberry.

The pollen is the minute white or yellow powder contained in the cells of the anther, discharged when ripe through the pore, or slit, or other rupture in the cell wall. In order to reproduce, it must be carried by some means to the stigma of another flower of the same kind. Pollen grains differ in size and shape in about as many different ways as there are kinds of plants. Usually the grains are single and separate, but often they are fastened together for some purpose in the plant economy.

b.—FEMALE FLOWERS.

The pistil (the female organ) of a flower consists of three parts: the ovary, the style, and the stigma.

The ovary is the sack or pocket containing the minute ovules, the germs of future seed. The ovary may consist of a single cell or carpel, as in the pea; of a double one, as in the mustard; of two separate ones, as in the parsnip and the maple; of three cells, as in the watermelon; of four, as in the evening-primrose; of five, as in the apple; of ten, as in the lemon, etc.

The style is the stalk, and may be very short, as in the squash; or none at all, as in the pine tree; or many inches in length, as in the silk of Indian corn. The style of a compound fruit may be simple, and usually appears simple, as in the evening-primroses, the mints, and the solanums. In the evening-primrose, the long slender style arising from a four-celled ovary, spreads at the top into four stigmas. This indicates that the style, small and slender as it is, contains four tubes for the passing of the pollen down to the ovules.

The stigma is the receptive end of the style, though not always the very end, as in the corn, in which the whole side of the exposed portion of the silk is receptive.

This silk contains on its sides rows of very short hairs, standing at an angle of about sixty degrees from the silk. These are for the purpose of holding the grains of pollen that fall upon the silk. In the axil of each hair there is a minute pore, through which the pollen finds its way to the interior of the silk, whence it passes down to the ovule at its base. It is known that the contents of a single pollen grain falling upon a silk will find its way down to the

ovule. The contents of a single grain, however, are all that is needed to produce the grain of corn. Should no grain of pollen fall upon the silk, or should the silk become cut, as by a cutworm, or broken before receiving a grain of pollen, there will be no grain of corn on the cob at the base of that silk.

c.—NEUTRAL FLOWERS.

There is still another class of flowers besides male and female,—the neutral flowers. They have neither stamens nor pistils. They are usually large and showy, and are produced by cultivation, as in the snowball and hydrangea. Such plants are not reproduced from seed, but are propagated by other vegetative methods.

d.—PECULIARITIES OF FLORAL ORGANS.

Although at normally equal distances around the pistil, it sometimes happens that the stamens group themselves in a certain direction, as though the presence of the anthers in that direction were needed.

In most flowers of the pea family the lower nine of the ten stamens are joined together by their filaments, forming a sort of split tube that enfolds and protects the pistil. The end of the pistil is bent sharply upward. The ends of the filaments are free, alternately long and short, and all bent upward, carrying the anthers on their tips. The two lower petals of the flower are united, forming a sort of shoe, called the keel (because somewhat boat-shaped), that incloses, protects and hides the essential organs. Nectar is abundant and sweet-scented, and the flower stands wide open, inviting the visits of flying insects. A bee, for instance, in search of nectar, lights on the horizontal keel. His weight bends the keel down a little. The strength,

size, shape, color, and odor, of all floral organs are nicely adjusted to the requirements. The pistil and stamens, being in the middle and not being stepped on, do not sink. First, the stigma of the pistil touches the bee on the under side and removes some of the pollen he carries from other flowers previously visited. Then the bee, crawling forward a step or two, receives a fresh supply of pollen from the anthers, which are nearer the nectary than is the stigma.

The stamens (eight) in the gauras and (many) in the cacti are declined downward, as the pistil in those flowers is so large and heavy it falls to the lower side of the flower.

The stamens in the figworts, mints, and others, are declined upward in (one or two) pairs, with their anthers united, and facing downward, ready to powder the back of any large flying insect that comes for nectar. The fifth or lowest stamen, not having a mate, is quite rudimentary, and is never furnished with an anther.

In the pentstemon the fifth stamen grows to full size, and, finding itself neglected in the struggle for perpetuation, bends sharply upward, closing the passage to the nectary against creeping insects which do it no good, but not closing it against the proboscis of a butterfly, a desirable insect, which brings pollen from another flower and carries away pollen to another. The stamen, after closing the orifice, stands straight out among the other stamens, simulating a pistil and deceiving some insects, which, seeking to avoid it so as not to get sticky, get against the true pistil, and leave pollen brought from another flower.

In the salvias (the true sages) the filaments are very short and the two cells of the anther are separated by a

long connective, balanced on top of the filament like the cross-beam of a well-sweep. The large half-anther on the short lower end has no pollen and the small half-anther at the long upper end is well supplied with pollen. If the lower half-anther ever had any pollen, it is clear that only the pollen of the upper half ever succeeded in reaching the pistil of another flower; and so, in the economy of nature, there being no further use for pollen in the lower half, no pollen is developed there any more; but the weight of the organ remains as a balance to the vitalized end, in order to hold it in the proper position during an insect visit.

In the common prickly-pear of our Western plains, the stamens are very irritable, and when a bee or other insect lights upon the flower, the stamens suddenly spring into the center, dusting the insect all around with the pollen.

In the pond lilies the filaments of the outer whorls are expanded more and more, and the anthers reduced until the stamens are transformed into petals. The gradation from petals to stamens is complete.

2.—FERTILIZATION.

Hops have their male and female flowers on separate vines. They depend on the wind for fertilization. They are propagated largely by division from the root. In planting a hop vineyard young female plants are planted mostly. But it is necessary in every vineyard, in order to secure a profitable yield of hops, that at least one male vine be planted for every hundred hills. The best success comes from planting a male vine at every fifth pole all around the margin of the field. Within, the male vines

need not be closer than the tenth pole in any given direction.

A fruit may sometimes be a compound flower or a house of several chambers. The apple is a case in point. In this fruit there are five chambers, each containing four ovules capable of being developed into seeds. The stigma of an apple, though apparently simple, is five-fold, and requires at least five grains of pollen, judiciously distributed, for the perfect fertilization of its twenty ovules. But, though the pollen is not always well distributed, it usually receives more than that; so that fertilization of an apple does not often fail.

Fertilization of one side of an apple does not necessarily fertilize all sides; but that does not prevent the apple from developing into a full round apple; (though it may, and undoubtedly does, prevent the apple from developing most perfectly.)

In the case of a tomato, a berry containing five cells separated by partitions, fertilization of one only of its cells causes that side to develop and grow to full size; while the cells which have not received pollen fail to develop, causing the fruit to be one-sided and misshapen. Growth of a cell may be made circumferentially as well as radially. For instance, a single cell may take up two-fifths or more of the circumference of the fruit; and thus the lack of pollenization of any of its parts may not be well noticed.

Similarly, if one of the three cells of a melon, pumpkin, or other cucurbitaceous fruit, were to be prevented by any means from becoming fertilized, the other two cells would fill all the space, crowding two of the walls or partitions close together with only the undeveloped ova between them.

Prof. Bruce Fink, of the Minnesota Botanical Survey, Minneapolis, Minn., has performed a number of experiments in pollination of the common tomato, and learned this: That removal of the stigma or a part of the stigma of a flower does not prevent fertilization; as pollination of the cut portion of the style was quite as effective, owing to the viscous sap, as when pollination is effected in the regular way. He also found, after many experiments, that twelve hours is about the time required for the contents of the pollen grain to pass from the stigma to the ovary.

When the ovary of a flower is fertilized by pollen from stamens of the same flower, it is termed close fertilization. It is akin to inbreeding in animals. Continued inbreeding in plants, as in animals, has a tendency to weaken the vigor and vitality of the plants.

To prevent this, nature provides in many ways for cross-fertilization, or for the reception of pollen from a different flower and plant. One of the most obvious of these methods is the separation of the males and females into separate flowers on the same plant or tree; and, quite often, separation to separate plants or trees.

Such trees usually depend upon the wind for pollination. Such pollen is not adhesive and does not stick to insects. The stigmas are adhesive and hold the pollen grains that fall upon them. The flowers of trees that depend on the wind for pollination are inconspicuous, like the hazel, willows, elms, maple, ash, box-elder, cottonwood, the oaks, hickories, walnut. And yet it is known, that most of them attract insects; bees fly out on the first warm days of spring and come back loaded with pollen, when nothing of consequence is in bloom but maple, elm, and willow.

During the first few warm days, about the 20th of March, when the blossom buds have burst and the little stamens begin to hang down, if a twig be taken into the house and placed in a vase of water, in about 24 hours it will be seen that the stamens have lengthened and the anthers at their tips have swollen and burst, showing the yellow pollen. If now a sheet of paper be placed under the twig and if the twig be gently tapped a surprisingly large quantity of yellow pollen may be collected on the paper, thus showing the vast quantities of pollen that are developed in the flowers of trees that depend on the wind for fertilization.

The pollen of such trees is nearly always yellow, varying in the different kinds of trees from a pale yellow to a deep sulphur yellow; it is very fine, like the dust of flour, and capable of retaining vitality while being carried long distances, even many miles, by the wind.

Among the trees that depend on the wind for pollenization of the female flowers are all kinds of willow, cottonwood, maple, elm, ash, oak, hickory, walnut, and sycamore.

Trees which have their male and female blossoms growing on separate trees are the willows, box-elder, white ash, green ash, cottonwood, Carolina poplar, silver poplar, mulberry (sometimes), honey locust, coffee bean, ailanthus, hackberry (sometimes), buckthorn (usually).

Trees which have both kinds of blossoms growing separately on the same trees are the maples, elms, buckeyes, hackberry (usually), mulberry (sometimes), oaks, hickories, pecan, walnut.

Trees which have "perfect" flowers are redbud, all our fruit trees, hawthorn, crabapple, pawpaw, black locust, wild cherry, buckthorn (sometimes), basswood.

There is a constant tendency among all our trees toward diœciousness; that is, toward having the male and female floral organs on separate trees. For, whenever trees and plants are aided effectively in the dissemination of pollen, there is begotten in the future tree a dependence upon that aid and a tendency toward stronger sexuality one way or the other. Thus, new varieties of plum, grape, strawberry, etc., show a much stronger tendency toward the separation of staminate and pistillate flowers than formerly; other trees, as mulberry, hackberry, which theoretically have perfect flowers, show a strong inclination, in the most vigorous growing kinds, toward having special characters, as staminate or pistillate organs alone confined to an individual tree. And trees that are strictly diœcious show no tendency whatever toward a reversion to perfect flowers.

On the other hand, inbreeding and self-fertilization in plants beget a tendency toward perfect flowers and facilities for inbreeding. Such trees and plants are not so vigorous; and in the struggle for existence are liable to be crowded out by the stronger plants whose life came from cross-breeding.

3.—PROVISION FOR CROSSING.

In the case of our domestic fruits, which all have perfect flowers, various expedients for the prevention of inbreeding take place.

1. The opening, in all kinds of fruit, of the anther in such manner that at time of opening it is turned upward or even away from the stigma in such fashion that pollen may be deposited upon the sides of a bee or other insect and carried away to another flower.

2. The reduction of certain organs, leaving the organs of the opposite sex to develop fully. This is especially true of the strawberry, in which many plants bear female flowers only; other plants have both sets of organs, but with one or the other more or less imperfectly developed. Varieties differ in these respects. In case a variety happen, like Crescent, or Princess, or Warfield, to be entirely pistillate, it is necessary to plant some variety carrying stamens, as Captain Jack, Cyclone, or Wilson's Albany, some variety coming into bloom at the same time, in the patch, to the number of say one row in three to one in ten, in order to have any berries.

Plums are prone, both in our cultivated and wild varieties, to vary in such ways as to prevent self-pollination and to encourage cross-pollination. Stamens in some have long filaments, holding the anthers high above the stigma; in other flowers the reverse is true; the stamens are reduced and ineffective. On account of defective stamens in the plum and cherry and grape, in many orchards and vineyards, and on account of inability of some varieties of plums to fertilize themselves, it is not always best, if you happen to have one tree or vine, that is a vigorous bloomer but a shy bearer, to cut down that tree or vine. That mistake has often been made, to the detriment of the orchard and the discomfiture of the owner.

Another method of preventing self-pollination is the maturity of the organs on different days. This is quite common among all our domestic fruits, especially apple. Usually, in the case of the apple, it is the pistil which is first ripe and ready for the reception of the pollen; the stamens are still growing and are not ready to discharge

their pollen until the next day or day after. By that time the pistil will accept no more pollen, being satisfied.

Our garden fruits are insect-loving. Every detail of development in our fruits is for the purpose of inducing insect visits, especially those of bees. Color, form, odor, location of nectary, and methods of reaching it, are all best adapted to bees. It has been noticed that bees, when working on any flowers, visit that kind of flower only, and do not pass promiscuously from flowers of one species to those of another species or kind. Thus, while every effort is made by the flower to induce cross-pollination, it rarely happens that circumstances favor hybridization.

The question is often asked why the seed of any particular variety of fruit would not produce the same kind of fruit. The reason is very obvious. The flowers of no one variety can be depended on as having been pollenized from flowers of the same variety, since bees and insects visit all flowers which are agreeable to them; though the bees do not visit them promiscuously. It is a provision of nature that the pollen of any species of plants will only pollenize plants of the same species. When carried to the stigmas of flowers of a different species they remain inert or inactive; but they are active enough in the case of different varieties. When the flowers of any particular variety of fruit receive pollen from some other variety of the same fruit, and the resulting seed is planted, the fruit of the new tree, vine, or bush, should partake of the nature in part of both parents. It does not always follow that the resulting product is superior to both of the parent vines, though it sometimes does happen that way; and in this lies the skill or success of the seedsman or pomologist, that he

may produce a variety of fruit superior in certain respects to anything else, and out of many trials reject and destroy all which do not reach the standard required by him.

R. M. Kellogg, who raises great crops of small fruits, says:

“Plants have their love matches and affinities. They receive pollen from one plant and reject it from another. They give evidence of enjoying the presence of some plants, while others are repulsive. Like the human family, different varieties have decided preferences for certain localities and environment; and one variety will not thrive on a soil deficient in some particular kind of plant food, while another would flourish there grandly.”

These peculiarities being so, it becomes necessary for the careful horticulturist to study the habits of his plants, their likes and dislikes; for in no other way can he achieve the highest success.

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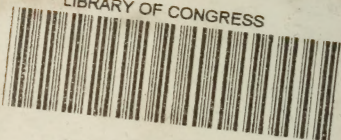
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